MODERN MECHANICS AND INVENTIONS

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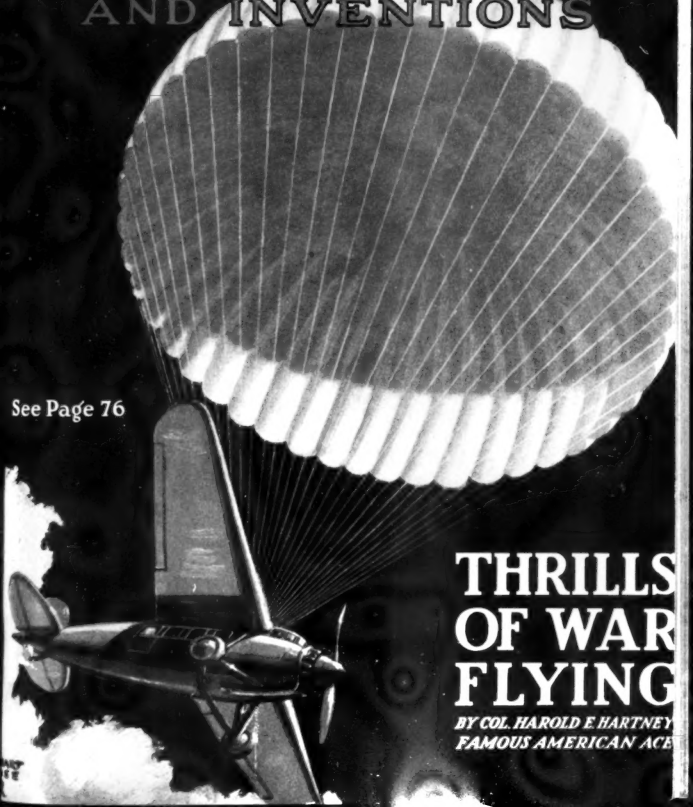

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BY COL. HAROLD E HARTNEY
FAMOUS AMERICAN ACE

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Mechanics, Office Men—Beginners, Clerks—at once

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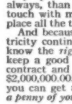

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VOL. I NO. XI
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1929
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MODERN MECHANICS AND INVENTIONS

A FAWCETT MAGAZINE

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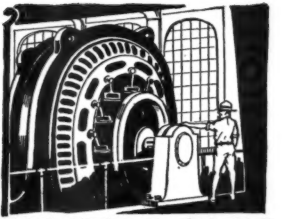
You Fellows Who Want BIG PAY Get into ELECTRICITY



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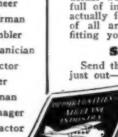

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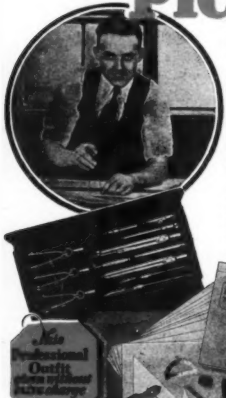

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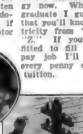

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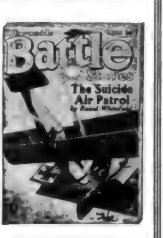

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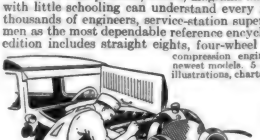

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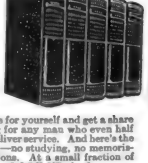

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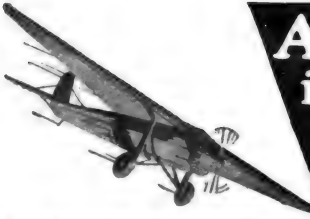

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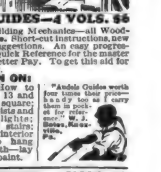

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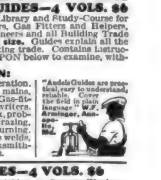

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LAST month, in March, the article on the building of the Heath Super Parasol was concluded. This popular article made Mr. Rouse a host of friends and drew to Modern Mechanics an army of light airplane fans who evidently have been waiting for an enterprising magazine to gather just such material and present it in form which everybody understands.

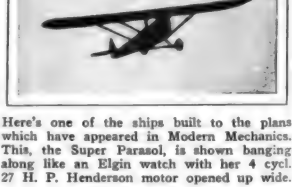
We are glad to present this month the Russell-Henderson monoplane, designed by Chas. E. Russell. Mr. Russell has been building and designing light airplanes for a long time, and the skill he has acquired is readily apparent to any airplane enthusiast. The clean lines of this little plane as described on page 54, coupled with the super-strength wing, the excellent visibility, and the simplicity of her framing are highly interesting to those who know their sky ships.

Concerning light airplanes, we have the following letter from a reader who thinks the Parasol won't fly. Just to prove it we are shooting in a little snapshot, taken on a vest pocket kodak, of the Heath in flight at about 500 ft.

When we got the letter, Stewart Rouse sent us a couple of photos, one of them showing Ed Heath cruising along at about 3,000 ft. over Chicago. We'll run this latter shot next month. The letter:

I like Modern Mechanics better than anything I ever read and can't wait till next month to get the next copy, but I don't think you should publish plans of airplanes like the Heath Parasol, because it won't fly with a Henderson motor. I have a friend who is a pilot and he says so. He says he doesn't think such an airplane will fly, with a motorcycle motor.
Jackson, Mich. Ed Riebens

We wrote Ed and told him that Heath has flown the old style Parasol with using the lower wings from a Thomas Morse Scout, a design over 10 years old. More than that, the engine used was the old 23 h.p. model instead of the new 27 h.p. model specified for the conversion! With the new Clark Y high lift wings and the 27 h. p. motor the Super Parasol climbs better than a Jenny and will lift about 100 lbs. more than its normal loaded weight with a 150 lb. pilot. That information ought to satisfy Ed! How about it, old timer?



Here's one of the ships built to the plans which have appeared in Modern Mechanics. This, the Super Parasol, is shown banging along like an Elgin watch with her 4 cycl. 27 H. P. Henderson motor opened up wide.

Every ship design published in Modern Mechanics is flight tested after actually having been built, and will stand all stunts. We are giving the hangar hounds real airplanes, not paper dreams.

When you have built a plane from a Modern Mechanics design, provided you have not altered the plans one whit, you will have as well a turned out airplane as is made in many factories.

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T. J. Osborne two days after receiving sample case enthusiastically writes: "I have been out only two evenings and have taken orders for $24.85."

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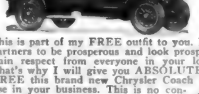

This is part of my FREE outfit to you. I want my partners to be prosperous and look prosperous to gain respect from everyone in your locality. That's why I will give you ABSOLUTELY FREE this brand new Chrysler Coach to use in your business. This is no contest! It is yours to keep just as soon as you show me you are in earnest. Send coupon today.

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Flashes from Modern Mechanics' Shop Mail Box

MR. HENDERSON'S article on the part science plays in detecting criminals and fugitives was very much liked by all who wrote to the editors commenting upon the way the magazine appealed to them.

Up in Maine a Modern Mechanics fan has built one of the air-propelled ice sleds, similar to the one described in the February number of the magazine.

Among the most favorably received of all the magazine's cargo last month was Roger W. Babson's splendid outline of seventy opportunities which, if capitalized, could easily net the enterpriser a fortune. This is the original article which has been so widely commented upon in the press.

Carl H. Duede's glider story brought in a storm of inquiries. Mr. Duede has a well worked out little ship in this glider. Some fine views came in recently of this small plane and we'll run them next issue along with the one of the Modern Mechanics Parasol with Ed Heath at the stick.

If "Airplane Camping Tours" was popular, wait till you see the account of a cruise along the coast of California in a Bristol Cherub Parasol! The story is being written as you read this and will be included in an early issue.

One of the hangar gang sends us a big salute from Auburn, Maine, where he has built a motor ice sled, the power plant of which is shown here. Our good friend neglected to send us his name, but he is evidently in the Indian motorcycle business because the motor pictured is an Indian and his stationery bears the Hendee trademark. It drives a light sled, patterned somewhat after that designed by Gilbert Mickelson, plans of which appeared in blueprint form in February issue. Says our friend:

—the sled will go 50-60 miles with ease and has caused considerable comment. The motor is converted substantially as shown in the December issue of the magazine. The propeller is a professional job.

As this man did not sign the letter we are at a loss to answer his good missive and to thank him.

DOWN in the Canal Zone E. H. Williams read "How to be a Scientific Detective" and after putting the magazine on the shelf, he took "pen in hand" to let us know:

I was very much interested in Mr. Heinrich's capture of the D'Autremont bandits. I saw their pictures in the local postoffice and was intensely interested in the inside story of how they were apprehended. I can't say I like the cover, but it is different. You have a magazine that at last has some grown up man size intelligent plans for building things. I am enclosing my subscription and want the subscription to start with the January issue so I'll have the plans I want complete.

E. H. Williams, C. E.
Curzon, C. Z.

Next month we have a great cargo planned. In plotting the course of the good ship Modern Mechanics we have lined up stories on how bandits are foiled in trying to rob trains, how whales are hunted for sport, and a story of the largest dam ever built, which is soon to be thrown from mountain top to mountain top in California. To build this monster, a crew of 1,800 men will have to pour 2,000 tons of concrete a day for five solid years!

Gilbert Mickelson will be on deck again with a corking good story on building an electric launch. The story of the *Tim*, which was a little sailing dinghy until Jim Smith and Bob White made a launch of her, shows how an electric 6 volt starter was made into a marine engine and how the boys took a ride in her. The power furnished by two storage batteries was sufficient to drive the boat with one of the lads in her at a rate of 7 miles an hour. Coming for May!

And the flying boat, and the seaplane, and the article on floats, and the Baby Bullet details will all be along. Have patience!

As our friend Al Jolson might say, "You ain't seen nothin' yet!"

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The

Flying Manual

Published by MODERN MECHANICS AND INVENTIONS MAGAZINE

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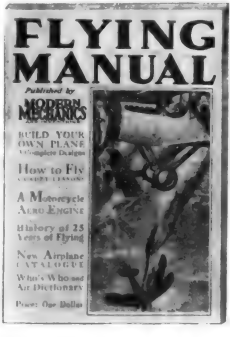

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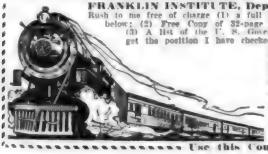

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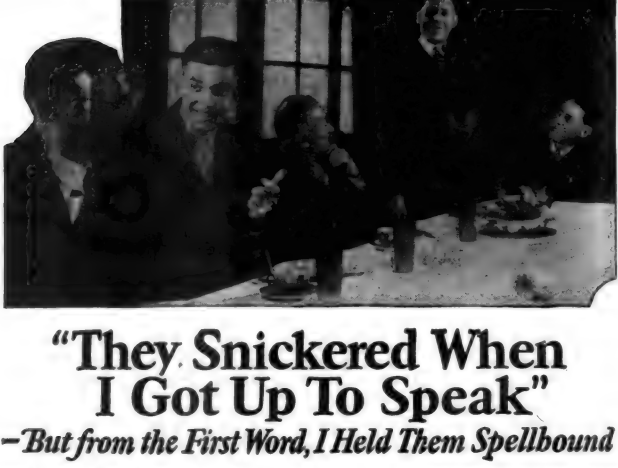

"They Snickered When I Got Up To Speak"

—But from the First Word, I Held Them Spellbound

THE banquet hall was crowded. Suddenly I heard the chairmans' voice say—"We will now have a few words from Mr. Byron Munn." It came like a flash of lightning! He was unexpectedly calling on me for a speech!

As I started to get up, I heard a titter run around the table.

"Watch him make a fool of himself." I overheard someone whisper. "He's so bashful he's afraid of his own voice."

I knew they were expecting me to make myself ridiculous, but I only grinned inside.

I stood squarely on my two feet and started in!

"But When I Commenced to Speak"—

Almost from the first word, the smiles and derision faded from their faces. They were incredulous—amazed! Instantly the atmosphere became so tense that you could have heard a pin drop! No snickers nor sneers *now!* My voice, clear as a bell—strong, forceful, unfaltering—rang out through the banquet hall as I hammered home each point of my message with telling strokes! I let myself go—soaring to a smashing finale that almost brought them to their feet!

When I finished, there was an instant of dead silence! And then it came—a deafening wave of applause rolling up from one hundred pairs of hands—spontaneous, excited, thrilling!

What 20 Minutes a Day Will Show You

How to talk before your club or lodge.
How to address board meetings.
How to propose and respond to toasts.
How to make a political speech.
How to tell entertaining stories.
How to make after-dinner speeches.
How to converse interestingly.
How to write letters.
How to sell more goods.
How to train your memory.
How to enlarge your vocabulary.
How to overcome stage fright.
How to develop self-confidence.
How to acquire a winning personality.
How to be the master of any situation.

Was Once a "Human Clam"

After it was all over, Jack Hartray fell into step beside me as I left the hall. "Gee, that was a great speech!" he said enthusiastically. "You certainly raised yourself about 100% in the eyes of every person in that place tonight. . . . And yet they used to call you 'a human clam' —and the quietest man in the office!"

It was true too. All my life I had been handicapped with a shy, timid and retiring nature. With only a limited education I never could express my ideas in a coherent forceful way. As a result I saw dozens of men with less ability pass me by simply because they were good talkers and knew how to create the right impression. It was maddening.

A Lucky Accident

At last I accidentally ran across a little book entitled *How to Work Wonders With Words*. Between its covers I discovered certain facts and secrets I had never dreamed of. Difficulties were swept away as I found a simple way, to overcome timidity, stage-fright and self-consciousness—and how to win advancement, popularity and success.

Today I hold the sort of position that I had always envied. My salary has been increased! I am not only in constant demand as a speaker in public but I am asked to more social affairs than I have time to attend. To sum it all up, I am meeting worth-while people, earning more than I ever dared expect and enjoying life to the fullest possible degree! And furthermore, the *sheer power of convincing speech* has been the big secret of my success!

The experience of Byron Munn is typical. Not only men who have made millions, but thousands of others have found success after learning the secrets of powerful, effective speech. Being able to say the right *thing* in the right *way* at the right time has perhaps been responsible for more brilliant success than any other one thing under the sun!

Get This Amazing Book FREE!

Right now, we offer to send you absolutely free, a copy of *How to Work Wonders With Words*. This remarkable little book will show you how to develop the priceless "hidden knack" of effective speech that has brought success, social position, power and wealth to so many. It will open your eyes to a new realization of what life holds in store. See for yourself! There is no obligation. You can obtain your copy free by just sending the coupon.

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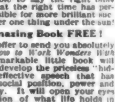

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"Can he really play?" a girl whispered. "Heavens, no!" Arthur exclaimed. "He never played a note in his life."

They Laughed When I Sat Down At the Piano But When I Started to Play!—

ARTHUR had just played "The Rosary." The room rang with applause. Then to the amazement of all my friends, I strode confidently over to the piano and sat down.

"Jack is up to his old tricks," somebody chuckled. The crowd laughed. They were all certain that I couldn't play a single note.

"Can he really play?" I heard a girl whisper to Arthur.

"Heavens, no!" Arthur exclaimed. "He never played a note in all his life. . . ."

I decided to make the most of the situation. With mock dignity I drew out a silk handkerchief and lightly dusted off the keys. Then I rose and gave the revolving piano stool a quarter of a turn. The crowd laughed merrily. Then I started to play. Instantly a tense silence fell on the guests. I played the first few bars of Liszt's immortal "Liebestraum." I heard gasps of amazement. My friends sat breathless—spellbound! I played on.

A Complete Triumph

As the last notes of the "Liebestraum" died away the room resounded with a sudden roar of applause. I found myself surrounded by excited faces. Everybody was exclaiming with delight—plying me with rapid questions . . . "Jack! Why didn't you tell us you could play like that?" . . . "Where *did* you learn?"—"Who *was* your teacher?" "I have never even *seen* my teacher," I replied. "And just a short while ago I couldn't play a note."

"Quit your kidding," laughed Arthur, himself an accomplished pianist. "You've been studying for years. I can tell." "I have been studying only a short while," I insisted. "I kept it a secret so that I could surprise you folks."

PICK YOUR INSTRUMENT	
Piano	Clarinet
Organ	Flute
Violin	'Cello
Drums and Traps	Sight Singing
Banjo (Plectrum, 5-String or Tenor)	Ukulele
Mandolin	Harp
Saxophone	Cornet
Hawaiian Steel Guitar	Piccolo
Voice and Automatic	Guitar
	Trombone
	Piano
	Accordion
	Speech Culture
	Finger Control

No Teacher Needed

Then I told them the whole story.

"It seems just a short while ago that I saw an ad of the U. S. School of Music mentioning a new method of learning to play which only averages a few cents a day! The ad told how a woman had learned to play the piano in her spare time at home—and *without a teacher!* The method she used required no laborious scales or exercises. It sounded so convincing that I filled out the coupon requesting the Free Demonstration Lesson.

"It arrived promptly and I started in that very night to study it. I was amazed to see how easy it was to play this new way. I sent for the course and found it was just as easy as A. B. C! Before I knew it I was playing all the pieces I liked best. Soon will be able to play ballads or classical numbers or jazz, with equal ease! And I never did have any special talent for music!"

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Thousands of successful students never dreamed they possessed musical ability until it was revealed to them by a remarkable "Musical Ability Test" which we send entirely without cost with our interesting Free Booklet and Free Demonstration Lesson. The Booklet will also tell you all about the amazing new *Automatic Finger Control*.

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I have invented a new Service Station Charger which saves 40% to 60% in electric current, yet handles 50% to 70% more batteries than similar outfits. Millions and millions of batteries in daily use by auto owners everywhere. Amazing new principle of my Service Station Charger simply scoops up all the business in town for you. My Free Book tells you how to get started.

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$5.00 is All You Need to Start

Clip coupon and get your Free copy of my book "Big Profits." Read how hundreds of other fellows like yourself have established themselves in their own business. See the description of my amazing Service Station Charger. Find out about my plan for establishing you in this Big Pay field for only $5. Along with the charger goes my complete outfits of tools, supplies, testers, advertising—in fact everything that you need to do business—you can take in $20 a day or more right from the start. Get your copy of this book quick.

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365 KEEN SHAVES
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GET FREE OFFER

Send for full information on these surprising new inventions today. KRISS-KROSS products are never sold in stores. You deal direct with me or my authorized representative. Write for illustrated description and full details of free razor offer. It's even more remarkable than I can tell you in this short space. Clip the coupon now. Mail it today.

Agents $30 a Day and up

Make big money with KRISS-KROSS. Giving away FREE razors boosts your profits amazingly. H. King made $66 in one day. N. C. Paige made $104 in 3 days! Others average $350 and up to $750 a month! **Spare-time** workers, **Office** and **Factory** men make $6-$12 extra a day showing KRISS-KROSS to friends and fellow employees. S. Kantais made $154 extra just working evenings 3 weeks. Get details at once. Check bottom of coupon and mail it tonight!

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Find 5 Objects
Starting with the Letter "C"

There are many objects in the picture of the circus above, such as lion, balloon, Indian, automobile, rooster, boy, tent, etc. If you can find 5 that start with the letter "C," you may win a Big Prize. Just think of winning a wonderful new 8-cylinder Studebaker Sedan or $2,250.00 in cash, absolutely free. Somebody is bound to win. Why not you? Get busy right away. Find five objects starting with the letter "C," fill in the coupon below and send it to me at once.

List of Prizes

1. 8 Cylinder Studebaker Sedan.
2. Four-door Chevrolet Sedan.
3. Victor Orthophonic Victrola.
4. Shetland Pony, Saddle and Bridle.
5. Seven Tube Console Radio.
6. Fibre Living Room Set.
7. Electric Vacuum Cleaner.
8. Apollo Motorbike Bicycle.
9. 100-Piece Dinner Set.
10. Ladies' or Men's Elgin Watch.
11. 29-Piece Silverware Set.
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13. New Haven Banjo Clock.
14. Wrought Iron Bridge Lamp.
15. Ladies' Overnight Bag.

$550.00 Given for Promptness

In addition to the Studebaker Sedan, the Chevrolet Sedan, the Victor Orthophonic Victrola, the Shetland Pony and the many other valuable prizes—besides Hundreds of Dollars in Cash—I am also going to give $550.00 in Cash for Promptness. It will pay you to act at once. Any winner may have cash instead of the prize won and in case of ties, duplicate prizes will be awarded. There are no tricks or illusions of any kind and neatness or handwriting do not count. You will not be asked to write in any squares, add up any figures, build words, or solve any additional puzzles of any kind. Get busy right away. Find 5 objects starting with the letter "C," fill in the coupon below and send it to me just as soon as possible. EVERYBODY REWARDED.

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This is the First Prize Offered by

Screen Secrets

Magazine

To the Winner of the

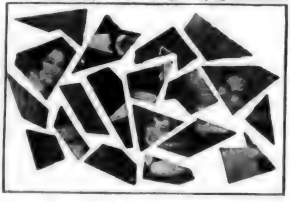
$1500.00 Puzzle Picture Contest

Three famous Hollywood stars are in this puzzle. Can you fit the pieces together and name them? Try it!

It won't cost you a cent to join this entertaining new SCREEN SECRETS contest. Just follow the simple rules and try for one of the big cash prizes.

Here are the Rules

1. Screen Secrets will award $1500.00 in cash prizes, as listed for the correct assembly of this puzzle picture and three others to appear in Screen Secrets Magazine, for the neatest presentation of the puzzles and the best brief biography on one star in each of the four groups.
2. Contest begins with the publication of puzzle No. 1 in the April issue of Screen Secrets Magazine, continuing through May, June and July.
3. Contestants must keep all puzzles until publication of final set in July Screen Secrets. Contest closes July 15, 1929. Any one may compete except Fawcett Publications employees and their families.
4. There are no entry fees, and contestants need not purchase Screen Secrets to compete. Copies may be inspected at public libraries, and it is permissible to trace the puzzles on plain paper.
5. All entries must be sent first class mail, prepaid. None will be returned.
6. The verdict of the judges will be final.
7. Duplicate prizes will be given tying contestants.



HERE ARE THE PRIZES	
1st Prize	$400.00
2nd Prize	$200.00
3rd Prize	$100.00
4th Prize	$75.00
2 of $50.00	$100.00
4 of $25.00	$100.00
5 of $20.00	$100.00
5 of $15.00	$75.00
20 of $10.00	$200.00
20 of $5.00	$100.00
50 of $1.00	$50.00
110 Prizes	**$1,500.00**

This puzzle ad also appears in the April issue of Screen Secrets Magazine

If you don't recognize these stars, Screen Secrets may help you, for each issue contains hundreds of movie photos as well as stories about the stars. The April issue, now on sale, in addition to puzzle No. 1, contains a new directory of stars, with facts of their lives; Alice White's Secret Diary, Chaplin's new leading lady, true story of the murder of a great director and many other articles. If your newsstand can't supply you, send 25 cents in cash or stamps to:

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Weight empty: 400 pounds.
Top Speed: 85 m.p.h.
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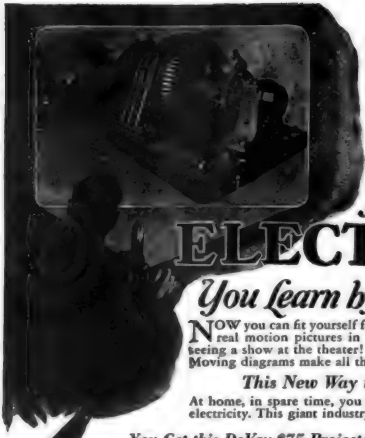

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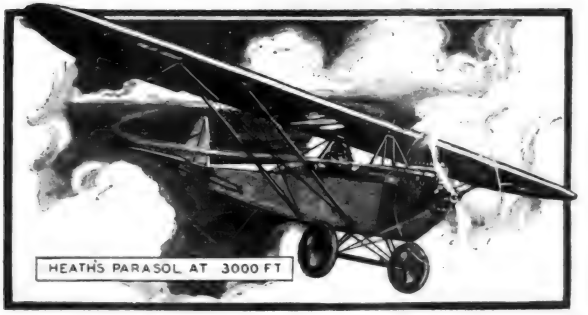
State.....

TAKE THE FILM WAY TO *Bigger Pay*



The FEEL of the AIR

TWO questions we are often asked sound something like this: "Why does Modern Mechanics feature air stuff so much? Why get excited over planes?" **We are excited over airplanes—especially light airplanes, and we feature aeronautical developments for two very good reasons.** First, and foremost, is the knowledge that the public is eager to be kept abreast of aviation—the tremendous success of Modern Mechanics proves it.

But fundamentally there is a deeper reason. Flying has just discovered that its fledging wings are fully feathered, safe, reliable and durable. Given pilots of intelligent training, this newest art which is now at the end of an experimental era may become one of the largest industries.

Without pilots, it will not advance. Without engineers it can progress nowhere. Aeronautics, introducing the third dimension into our present senses of motion in travel, is an art which calls for as much judgment, skill, and feeling as does painting, music, or any of the humanities. This feel of the air must become a part of the national consciousness before aviation will come into its own.

For a man to grasp the feel of the air is tantamount to saying he understands himself in relation to his ship and the air. When every American is as at home in an airplane as in a car, our goal will have been reached, and we will have vindicated our "excitement" over aviation.

And though Modern Mechanics can do no more than blaze a trail—the light airplane trail—by which the growing generation may acclimate itself to a new element, one of the planks in our publishing platform is dedicated to blazing this trail and will remain so dedicated.

We are proud of the fact we are championing the cause of the light ship. We are glad others can see we are excited. And if we can add to the total of national advancement in a new art by helping everyone become accustomed to the ways of things airwise we will have performed a fine service.

Get the feel of the air!

THRILLS of WAR FLYING

By COL. HAROLD E. HARTNEY

Veteran Wartime Flyer

Joining the Royal Flying Corps in 1914, Col. Hartney transferred to American forces in 1917 where he commanded the First Pursuit Group which numbered among its personnel such distinguished flyers as Eddie Rickenbacker, Frank Luke, Reed Chambers, and others.

SAUSAGE balloons, phosphorus bombs, swooping airplanes with iron crosses on their wings, spuming streamers of flame and smoke, a streak of orange fire as a *Drachen* tumbled down across a dull gray sky—this is the memory which remains to me of the first concentrated Allied attack on German sausage balloons during the war, a raid which sticks in my mind as the most thrill-jammed incident of my flying service. In those early days Allied pilots did not possess the swift planes and explosive bullets which made the destruction of sausage balloons in the latter days of the war merely a matter of evading enemy warplanes and firing a round or two into the heart of the gas-filled bags.

In June, 1916, the writer was a green, unseasoned pilot in the British Royal Flying Corps. The first battle of the Somme was in the offing. German observers in the baskets of their *Drachens*, as they called their kite-balloons, were learning altogether too much about the movements of the Allied troops. It became necessary to destroy these kite-balloons if the Allied plan of attack was to be carried out with any secrecy. A plan was carefully prepared in which the Air Corps was to launch a concentrated attack extending from the marshes above Ypres to a point 20 miles below Armentieres.

As a member of the 20th Squadron, my chance at last had come. The 20th was a combined observation, reconnaisance, and fighting squadron. We were fortunate in that we were equipped with the first Rolls-Royce engines, loaned to us by the British

Col. Hartney and Three Fellow War Birds Returning from France

Colonel Harold E. Hartney, author of the war time flying article on these pages, is shown above in the company of three other warbirds returning from France aboard the Mauretania. Reading from left to right, the officers are: Col. Hartney, Major Kenneth Littauer, Captain James Norman Hall, first American flier to be brought down by gunfire, and Captain Roscoe Fawcett, managing editor of Modern Mechanics and Inventions.

Navy. One fine day I received my orders to pilot one of the Rolls-Royce planes and serve as an escort for the Quirk bombers which were delegated to destroy the German "sausages."

Excitement around the camp was intense. Dozens of phosphorus bombs arrived, numerous dropping racks appeared. The dropping racks for the bombs had to be attached to the bombing planes at the air depot at St. Omer. At this time the phosphorus bombs were the only weapons we had for this particular type of warfare: the deadly inflammable bullets were unknown.

A Quirk was selected as the type of ship to carry the bombs. The Quirk was a cumbersome, slow ship, useful for its weight-carrying ability. After a very long run, it could climb to a ceiling of 10,000 feet with a load of four bombs. The duty of our Squadron was to protect the Quirk bombers, which were supposed to forget the enemy aircraft entirely and concentrate their attention on "laying the Egg" square on the hydrogen-filled gas bag. The bomb was timed to burst 100 feet above the balloon, spreading out like a Fourth of July sky rocket. The falling streaks of blazing phosphorus would ignite the hydrogen and send the balloon flaming to destruction.

I was detailed as one of the three machines to go out from our squadron as an escort. I had yet to meet my first opponent from the "other side of the fence." My Flight Commander had taken me out on a joy-ride over the trenches to look things over—a "Cook's Tour," as he derisively called it. I had heard the *Boom-Boom* and the *Whang* of the white and black enemy aircraft shells bursting, but as yet had not got into the thick of things on my own.

I was to pilot a plane mounting three Lewis guns, powered with a Rolls-Royce 250 h.p. engine which gave it speed and maneuverability far beyond that of the monoplane Fokkers equipped with poor copies of the French Le Rhone rotary engines. Our orders were to be above the Quirks and sweep the air clear of any planes over the sector from Ypres to Armentieres. I was walking out with my gunner to our big fighting plane when bomber No. 1 roared off down the runway, followed closely by bomber No. 2.

Neither had gained any perceptible speed before *Wham* went a bomb loose from the first plane, followed by a *Crash* as another dropped from bomber No. 2. The pilot of the second plane had seen the first bomb explode, and he started to veer his plane around out of the way when two more of his own bombs dropped and exploded. The bombs were constructed to open and spread phosphorus streaks in the air like a huge umbrella.

They did exactly that on the ground, spreading over the flying field and endan-

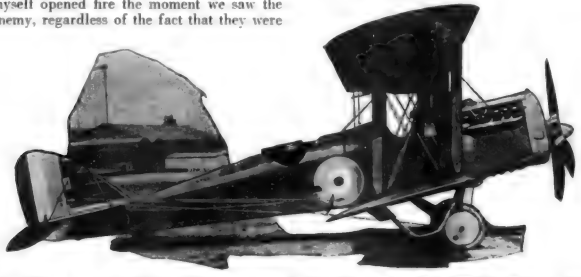
gering men and equipment. It was useless to run—you were just as likely to run into one of those blazing streaks as to escape it. So I just hunched up my shoulders and stood still. Fortunately I came out unscathed, as did my plane. But the first two bombers were not so fortunate. They flamed up on the instant, the pilots jumping just in time. Two more planes which had been on their way along the runway were caught in the raining phosphorus, and before our flight had as much as got started four of our planes had gone up in smoke. This destruction took place so rapidly that it was all over before we knew what was happening.

But the attack had been planned, and the attack must go on. The three remaining bombers got away, taking the air nicely, and the fighting planes followed. I gave my ship the gun, after glancing up to make sure that those dangling bombs were still clinging safely to the ships above. I had hardly banked in a climbing turn on a beeline for Ypres when I saw a balloon from the corner of my eye, far to the south. Thick bursts and streaks of fire and smoke were bursting in the air, the sign of our first attack. I reached the front line at about 4,000 feet elevation and ran bang into my first enemy planes. Three of them were intent on picking off the slow-moving Quirk I was escorting.

Being inexperienced, both my gunner and myself opened fire the moment we saw the enemy, regardless of the fact that they were well out of range. Our superior speed soon brought us up to them and all three turned tail, diving precipitously along three paths about 30 degrees apart. Bursts of castor oil smoke marked their path as they dropped out of sight. Fool-like, I followed, firing furiously all the time. Soon I found myself with two of the guns jammed at an altitude of only 1,000 feet, and what was worse we were eight miles within the enemy lines.

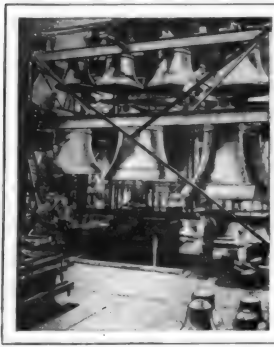
Swinging around quickly, my heart almost stood still as I saw two great bursts of phosphorus streaking down between ourselves and the lines. One burst had scored a hit. Instantly a balloon came flaming down directly in my path. Only by banking over suddenly was I able to avoid the burning bag as it streaked to the ground: I could almost feel the heat of the gases as it flamed past. When I made my way back over the lines to report to my Commanding Officer, I recall my thoughts vividly: "If every mission thrills and scares me as much as this one did, I'll die of fright and mental shock, rather than from enemy bullets, long before the war ends."

I was interrupted in my meditations by my own Flight Commander coming up with a cheery word of unmerited praise, so that I felt that the game was worth while after all—good sport, even if a bit nerve wracking.



The DH4, famed in stories of wartime flyers, is pictured above as it appeared in service. This plane had not been developed in the early days of the war of which Colonel Hartney writes, but was a favorite among pilots during the closing months of the struggle. The Liberty motor was developed for use in this type of plane. Note the machine gun mounting in rear cockpit.

World's Largest Carillon in Florida Bird Sanctuary



BELLS, bells—the tintinnabulation of the bells! Edgar Allan Poe might well have got his inspiration for his famous poem from the carillon pictured at the left, said to be the largest in the world. It was built in a bird sanctuary in Florida established by Edward Bok. Two dozen bells of various sizes were used in constructing this novel musical instrument.

OCEAN LINERS FIGHT FOR SPEED RECORD

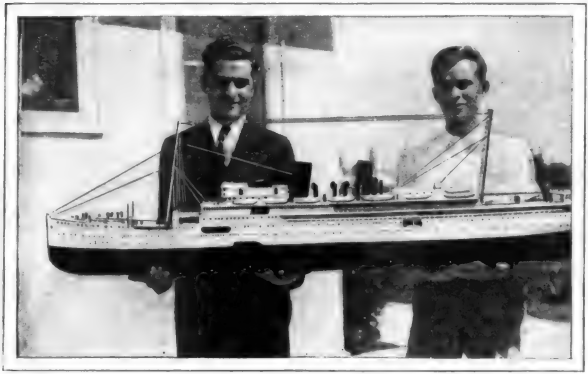
NEW records for speed in crossing the Atlantic are expected to be set by the new 27-knot ships now being built by the North German Lloyd Line. At present the crossing record is held by the *Mauretania*, which made the trip in 1910 in 4 days, 10 hours and 41 minutes, coast to coast. The *Mauretania* is a 26-knot steamer of the Cunard line.

FOLLIES BEAUTIES SELECTED VIA TELEVISION

TELEVISION is now used by Florenz Ziegfeld, famous producer of the Ziegfeld Follies, in selecting beautiful chorus girls from all over the country to take part in his musical productions. He has purchased one of the first commercial television sets in the United States for this purpose. The photo below shows Mr. Ziegfeld, in the center, studying the televised picture of a young lady who is 3,000 miles away in Hollywood. The set is known as a Jenkins Televisor, recently described in detail in the pages of Modern Mechanics, and, as the photo shows, the receiver can be placed on an ordinary business desk ready for use. All that is necessary is to hook it up to an ordinary radio set. When Mr. Ziegfeld discovers a likely prospect he has her come to New York at once.

Florenz Ziegfeld, producer of the famous Follies, is shown above selecting chorus girls through a television set.

Boys Build $350,000 Business Making Ship Models



WITH nothing but an idea, a pair of keen pocket knives, a few pieces of lumber and a ball of twine, two boys of Pasadena, Cal., have built up a business for the manufacture of model ships which, after seven years, they have recently incorporated for $350,000. The two boys are Roscoe and Wallace Good, brothers, shown in the photo above holding a model of the *City of Honolulu* which has just been completed after six months' of painstaking effort. The model is valued at $2,500, and is said to be the only metal plate replica in existence. It is complete in every detail, even to tiny electric lights which flash inside the cabins. Each deck has been furnished with scores of tiny chairs and tables, all hand carved, and doll-size lifeboats swing realistically from their davits. Good Brothers Co., Inc., as the boys have named their business, builds models of all types of ships.

BATHING IN A TUB FULL OF WHIPPED CREAM!

EVER take a bath in whipped cream? This seems to be what the young lady in the photograph is doing, but it only goes to show how the camera can be fooled. The foamy suds come neither from whipped cream nor soap, but are produced by a chemical perfected by a Dresden experimenter. All that is necessary is to mix the chemicals with warm water, and the foam appears all ready for use. The purpose of this peculiar type of soap suds is to make it possible for a person to take a sweat bath without subjecting himself to an abnormal temperature or imposing any undue strain on the heart. The foam forms an almost air-tight covering.

Army Back to Blue Uniforms

At the left above the army's new blue dress uniform is being worn by Frank G. Hanlon. The soldier at the right is wearing olive drab.

CIVIL war days when the Union army was dressed in blue are brought to mind by the recent government announcement that Uncle Sam's soldiers are to be outfitted with brand new blue dress uniforms. One of the new uniforms is shown in the photo at the left, worn by an officer whose new suit is being examined by a fellow soldier dressed in the familiar olive drab.

NEW MEXICO HAS "BURNING GLACIER"

AN ASTONISHING deposit of gypsum "snow" near the city of Alamagordo, New Mexico, has been picturesquely termed a "burning glacier" because of its flowing, drifting movement. The deposits of gypsum cover an area of 270 square miles and in places reach a height of 70 feet, like enormous white sand dunes. The gypsum is a brilliant white which reflects the glaring New Mexico sun so brilliantly that the deposits are visible at a great distance. Interested scientists are urging the federal government to set aside the district as a national park.

Gypsum, which is used in the manufacture of cement and insulating material, has a commercial value which has caused plans to be advanced for building a railroad into this remarkable area.

JONAH POSES IN THE WHALE'S MOUTH

WHEN they captured a fifty-ton whale outside of San Francisco bay a short time ago, one of the workmen employed in landing the mammal stood inside the whale's mouth to demonstrate how easily it could swallow a man. There seems to be room for another half dozen men within the huge cavity. The engineering problem of getting the whale out of the water was solved by using a derrick barge. The whale was manufactured into soap.

MAN CROSSES SEA ALONE

CROSSING the Atlantic ocean all alone in his forty-foot yacht *Sturdy*, Capt. Edward Miller of the American merchant marine landed safely in Algiers after a voyage lasting for 55 days. Capt. Miller built his boat to his own design, bearing in mind that it must be worked by a single man. All possible comforts are provided in his tiny ship.

Collapsible Stick Prevents "Frozen" Plane Control

STUDENT aviators just learning to pilot an airplane frequently get themselves and their instructors into trouble by "freezing" to the controls when some unexpected maneuver of the plane causes them to lose their head. A student can grip the controls so tightly that the instructor is unable to operate the plane, and the result is frequently a crash in which both are killed. Several safety devices have been invented to overcome this danger, many planes having the instructor's control stick designed to exert more leverage than that of the student so that he can force it from his hands. In this case, however, the "feel" of the plane is lost. The control stick shown in the photograph can be instantly collapsed by means of the wire running towards the edge of the picture.

NEW MACHINES REPLACING LOGGING CREWS

LOGGING operations have been materially speeded up through the use of new machines which lumbering companies are now using. The old time lumberjack still holds his own when it comes to felling the big trees, but the process of moving the logs is greatly simplified by the use of log jammers, tractors, and powerful derricks which get the logs moving to the mills in short order. The photograph below shows typical logging operations in a modern lumber camp. Tractors have largely taken the place of horses and the old time skid has given way to derricks mounted on caterpillar trucks. Lumbering companies report that production costs are lowered by the new machines which displace many horses and mules.

Powerful derricks mounted on caterpillar trucks are shown above snaking the huge logs cut by the Red River Lumber Co. at Westwood, California. This tractor handles all logs quickly and easily.

New Electric Process Cuts Steel Costs

INDUSTRIAL chemists have been seeking a process of making high grade steel direct from iron ore ever since this metal became the backbone of American industry. If the intermediate steps now necessary in the refining process can be eliminated, billions of dollars will be saved annually, and the resulting decrease in the cost of steel will be reflected in a proportionate lowering in cost of new skyscrapers, bridges and other buildings, all of which are constructed around steel skeletons.

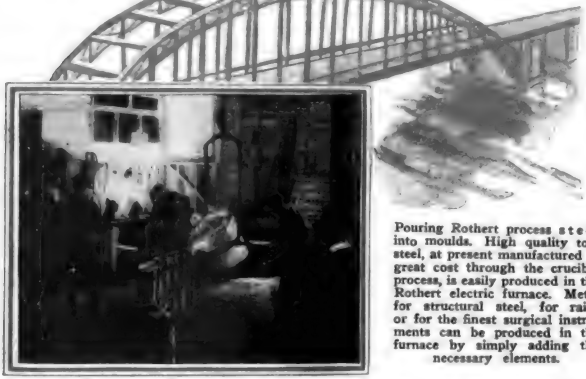
After many years of research and experiment Dr. E. H. Rothert, of Vancouver, B. C., has perfected an electric furnace by means of which a high grade of steel of superior qualities and uniform composition is produced direct from the iron ore.

Even refractory magnetite ores can be profitably converted into high-grade steel in this furnace. From these ores Dr. Rothert produces a steel capable of being manufactured into the best quality of knives, razors, dental tools, surgical instruments, dies, rivet sets, and all kinds of machine tools.

A plain carbon steel made by the Rothert process has a tensile strength of 128,600 pounds per square inch.

The furnace will turn out any desired specification of steel and it is therefore unlimited in its scope of application. It yields a product that gives a uniform analysis, free from blow-holes, of very fine grain, and capable of taking a very high polish.

The Rothert Furnace, which is patented in the United States and Canada, goes further than the dream of the early metallurgists, since it not only makes steel direct from iron ores but also makes available millions of tons of ores hitherto deemed



Pouring Rothert process steel into moulds. High quality tool steel, at present manufactured at great cost through the crucible process, is easily produced in the Rothert electric furnace. Metal for structural steel, for rails, or for the finest surgical instruments can be produced in the furnace by simply adding the necessary elements.

The new Rothert electric furnace will produce the finest grade of tool steel directly from iron ore, doing away with present complicated refining processes and saving millions of dollars for industry every year.

Tapping the Rothert electric furnace, which is expected to revolutionize the steel industry by making possible the manufacture of steel direct from iron ore.

worthless, an advantage which opens up a vast new field on the Pacific coast where this class of ore abounds in the midst of an hydro-electric field conservatively estimated to contain one-third of all the available water-power on the North American continent.

California, Oregon, Washington, British Columbia and Alaska may therefore, in the not distant future out-rival the east in the production of steel.

A brief reference to present processes will indicate the advantages of the new one. Iron ore is first reduced in a blast-furnace to pig-iron, which contains nearly all the original impurities. Another reduction is necessary to further refine the iron and convert into a steel suitable for rails and structural work, but to make a higher grade the metal must be submitted to a second refining in specially designed furnaces. Each system of refining requires special furnaces, with additional fuel, labor, and time, so that the ultimate cost of the finished product is increased by the cost of each treatment.

The Bessemer process, though not a direct one, was a great step in advance. In this method an egg-shaped converter invented by Sir Henry Bessemer, consumed the carbon and silicon in the metal by an air-blast forced through the fluid metal in the receptacle. The sulphur and the phosphorus still remained, and had eventually to be taken care of. A sufficient amount of carbon had to be re-introduced to produce steel.

The Bessemer process was not perfected for eight years. A lining was at last devised to take care of the sulphur and the phosphorus, which, with the addition of ferro-manganese after the hot blast, resulted in the production of the cheaper grades of steel for rails and structural work.

The introduction of heavier locomotives, however, caused Bessemer rails to break and split. The numerous accidents and consequent loss of life due to this cause called for a better quality of metals. Skyscrapers, too, were coming in to vogue, demanding greater strength in the material used. The open hearth process was then introduced. It was better fitted to meet the increasing demands for a higher quality of steel, but was not as direct or as cheap as the Bessemer process.

Additional and more complicated processes of refining must be resorted to for the production of high-grade tool steel, a demand which was met by the crucible process, a very laborious and costly one, which has supplied for many years all the high-grade steel of the world.

Riding the Big Waves on an Ocean Liner's Bow

HOW BIG IS A LINER?

IT IS difficult for a person who has never been aboard a large ocean liner to visualize their tremendous size, but in the photo below the photographer has caught an unusual view of the liner *Carmania* which gives a good idea of the proportions of a good sized boat. Note how the funnels tower to twice the height of the houses along the street.

OCEAN travelers with an unpleasant memory of seasickness won't care to look long at the picture on the left, showing the *Aquitania* cutting through the mountainous waves of the Atlantic while rushing to the rescue of the French freighter *Admiral Ponty*, whose crew she saved from the sinking ship. Some idea of the size of the waves the Atlantic can kick up when it sets out to "show its stuff" can be gained from a study of the picture. The cameraman has caught the spray breaking over the rails of the ship just as the wave is ready to crash onto the deck.

AIRPLANES DODGE KITES

KITES and balloons sent up by the aeronautics branch of the United States Department of Commerce for the purpose of taking daily observations of conditions in the upper atmosphere are anchored to the ground by piano wire which constitutes a danger to pilots of airplanes who are likely to run their machines into the wire without seeing it. A special warning to pilots to be on the lookout for these kites, which sometimes soar as high as 4½ miles, has been issued by the authorities, who urge special care in cloudy weather when the objects can be but dimly seen.

The liner Carmania is shown above in dock at London. Compare its dimensions with the houses in the street!

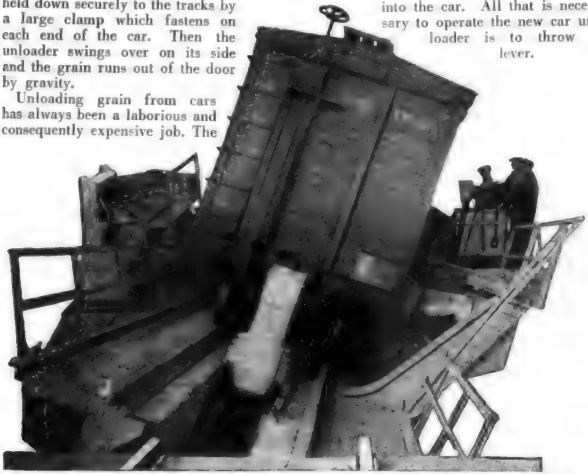
Giant Mushroom is Roadside Refreshment Stand

FOLLOWING the lead of Los Angeles shopkeepers who have found it profitable to erect all sorts of freak buildings in which to house their businesses, a German confectioner has constructed a unique refreshment stand which resembles a giant mushroom. The thatched roof adds to the realism by simulating the uneven surface of a mushroom's top. The projecting roof, however, is not merely an advertising novelty, but serves a good practical purpose in sheltering people from the weather, acting like an overgrown umbrella.

CAR UNLOADER HANDLES 40 CARS AN HOUR

ENGINEERS of the Pennsylvania Railroad have designed a mechanical car unloader for use in the company's grain elevator at Baltimore, Maryland, which can unload 40 grain cars an hour, or slightly more than one minute per car. As the photo shows, the car is run onto the unloader and held down securely to the tracks by a large clamp which fastens on each end of the car. Then the unloader swings over on its side and the grain runs out of the door by gravity.

Unloading grain from cars has always been a laborious and consequently expensive job. The old time method of shoveling it out by hand gave way to the modern automatic shovel, which is operated by two men stationed in either end of the car. The mechanical shovel is regarded as something of a man killer because it starts to pull back the moment the operator ceases dragging it into the car. All that is necessary to operate the new car unloader is to throw a lever.



The huge box car unloader shown above tilts a box car filled with grain so that it empties directly into the bins below.

Last American Full Rigger Still in Active Service

LAST of the full rigged ships in the American merchant marine still in active service is the *Tusitala*, shown in the photo at the left as she appeared in the harbor at Baltimore, Maryland, discharging a shipment of lumber from Honolulu and Seattle. Ships of this type formed the backbone of the merchant marine in the old days before the faster steam and Diesel boats, with their greater speed, forced them from the ocean lanes. Note the forest of spars, shroud lines and rope ladders. Deep water sailors who would feel at home on a ship like the *Tusitala* are rapidly dwindling.

BRITISH COAL MINES CLOSE

THE extent to which England has suffered from general trade depression during the past year is reflected in the announcement recently made in the House of Commons that 83 colliery companies operating 160 pits have gone into liquidation during the year. These companies employed about 36,000 people.

WOMEN IN AVIATION

GROWING importance of women in aviation is reflected in the fact that a number of the gentler sex hold pilots' licenses issued by the Department of Commerce. One of the newest women pilots is Jean La Rene, shown in the photo at the right, who has been soloing for two months and only needs a bit of instruction in stunt flying before she is ready to take her tests as a full fledged pilot. She is working on a Whirlwind motor, demonstrating that she knows just what it is that makes an airplane run.

FLYING TO THE POLE

ARRANGEMENTS for using the dirigible *Graf Zeppelin* on an Arctic exploration flight during April, 1930, are now being made by Dr. Fridtjof Nansen, the Norwegian explorer, to complete the work he began 35 years ago when he drifted across the polar sea in his famous vessel *Fram*. Dr. Hugo Eckener, designer of the dirigible, has already agreed to make the flight, and Dr. Nansen is now conducting negotiations with the United States government leading to the erection of a mooring mast at Nome, Alaska. The Russian government is expected to build a mast at Leningrad, to serve as a base for the giant *Graf Zeppelin*.

S-4 Sunk Again in Rescue Tests

Fitted with lifting eyes in the hull, the submarine S4 was sunk and raised again by Navy authorities testing new safety devices.

Above, Lieut. M. J. O'Boyle is pointing to the salvage air-line opening on the deck of the refitted S4. In the upper right hand corner Ed Boyle demonstrates the operation of the new escape lock. At the right the S4 is shown just before undergoing the tests.

Above the sinking S4 is pictured just before the water covered her. She was later successfully raised by means of pontoons attached to the new lifting hooks.

Germany Still Experimenting with Rocket Vehicles

BRILLIANT as the German technicians are, one often wonders what will come of the rocket experiments which German engineers have been making the past year.

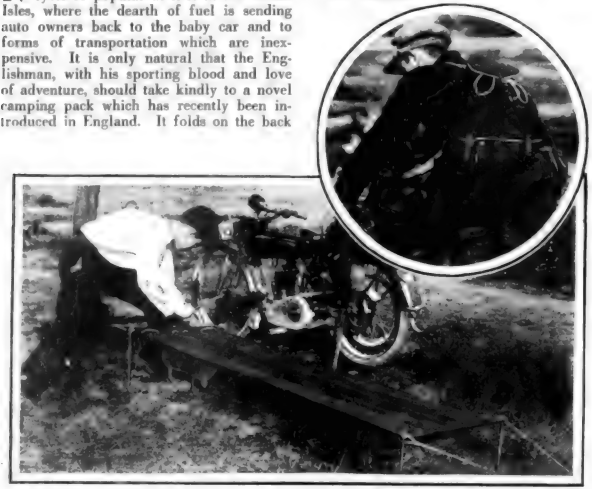
Airplanes, boats, railways, race cars and rocket projectiles—all have captured the fancy of Teutonic scientists, and the result has been a series of very interesting trials. To the left is shown a picture of the Opel rocket car, recently described in MODERN MECHANICS, speeding along under the impulse of her rocket propelling machinery on the Avus Speedway, near Berlin.

As a result of the Opel tests, in which the car went better than 120 m. p. h., Anton Raab, German airplane designer, has now under construction a rocket airplane which will be test flown shortly.

Motorcycles have also been experimentally driven by rockets.

MOTORCYCLIST'S CAMP KIT CARRIED IN PACK ON BACK

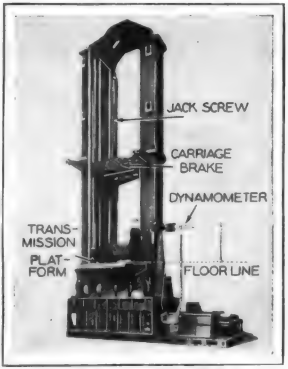
NOWHERE in the world is the motorcycle so popular as it is in the British Isles, where the dearth of fuel is sending auto owners back to the baby car and to forms of transportation which are inexpensive. It is only natural that the Englishman, with his sporting blood and love of adventure, should take kindly to a novel camping pack which has recently been introduced in England. It folds on the back and can be made into a complete camp in a few moments.



Tension Test Machine Measures Delicate Pressure

A GIANT tension testing machine capable of exerting a pull of two million pounds, yet so delicately balanced that the slight pressure of a finger tip can be sensitively measured, has recently been placed on the market. The photo at the right gives an idea of the huge proportions of the testing machine, which is the largest of its kind in the world. Note the man standing on the transmission platform and compare his height with the dimensions of the tester.

The machine is powerful enough to pull apart a six-inch billet of steel, yet the sensitive dynamometer can record the tiniest fraction of a pound when testing the tensile strength of a metal. Such testing is extremely important in construction work.



This machine is so delicate that it measures the pressure of a finger tip. Note the man standing on the platform.

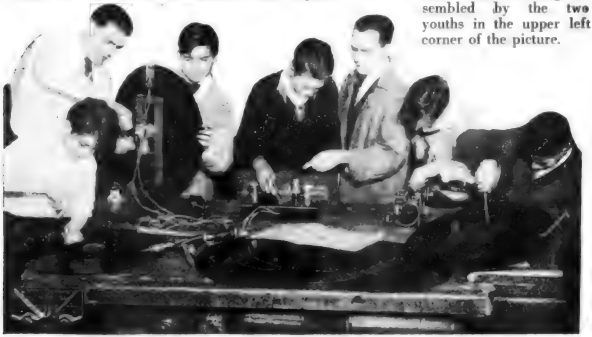
SAFE WELDING GOGGLES

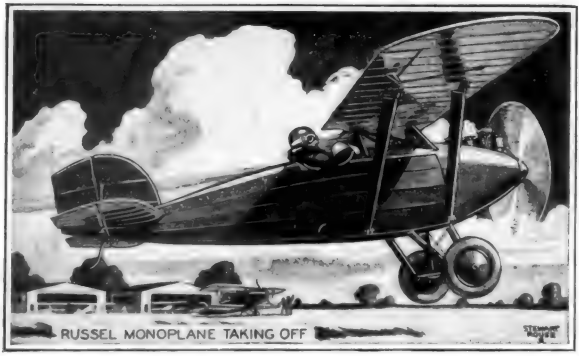
Welding goggles for small jobs are improved by grinding off the upper third of the lenses. The operator looks over the top until ready to weld, then through the lower part as usual.

HIGH SCHOOL BOYS LEARN THEORY OF TELEVISION

TELEVISION has advanced to such a stage of popularity that it is now studied in high schools as a regular vocational subject. The photograph below shows a group of students of Lane Technical High School, Chicago, assembling a television set under the direction of instructor Clark J. Herrengshaw, a pioneer in this field.

The scanning disk, which is one of the essential parts of the television set, takes considerable skill to make, inasmuch as the perforations through which the image appears must be drilled in the form of a spiral. One of these disks is being assembled by the two youths in the upper left corner of the picture.





The RUSSEL-HENDERSON LIGHT MONOPLANE

By CHAS. E. RUSSEL

A high factor of safety, good fuselage room, and adequate wing spread give this stout little plane all the qualities desired of a light airplane. Complete plans are presented.

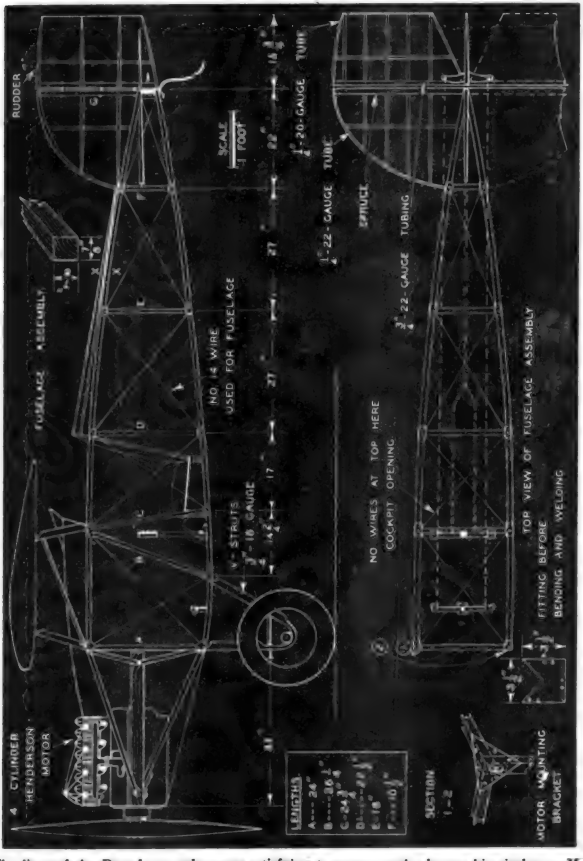
THE INTENSE interest created by the exploits of adventurous aviators during the past eighteen months has caused young America to resort to any and all methods to get into the air. The small light sport plane with a low priced motor is the result of this desire and some of the boys are having the time of their lives building their own.

In Europe, where gasoline is high, making small motors popular, the boys have a little "edge" on the lads over here due to the fact that small motors for airplane use are plentiful and comparatively cheap. For five or six years following the war a ninety or one hundred horsepower aviation motor could be bought for two or three hundred dollars. These motors were suitable for two and three passenger planes and of course this is what they were used in. There were no war surplus motors of the size and type adaptable to sport plane use. There was no demand for small planes as most flying at that time was strictly commercial and this work demanded larger planes.

The manufacturer of planes at that time could sell a three place machine complete with motor at a lower price than he would have to ask for the motor alone in a sport plane. The government had thousands of surplus OX5 ninety horsepower motors which he could buy for a song and consequently the small motor for sport plane use was not taken very seriously until Lindbergh gave aviation such an appeal to the masses that every man, woman and child in America wanted to fly.

Wide awake manufacturers are now pre-

Framing Details and Strut Measurements for Fuselage of Sport Plane



The lines of the Russel monoplane are satisfying to any one who knows his airplanes. Mr. Russel is one of the most prominent light airplane experimenters in America, and Modern Mechanics is proud to present in complete simple form plans for the latest Russel design.

paring to meet this situation by producing airplanes suited to the individual. This does not mean that the future airplanes will all be small; far from that, because they are making them bigger every day for the transportation companies. However, it does mean that young America has asserted itself and the manufacturers are striving to produce low priced, low powered, dependable sport planes.

A few are already on the open market and are proving highly successful. The price of these as yet is still a little steep for the average young man, but many are buying them nevertheless.

For the young man who cannot afford to lay down fifteen hundred or two thousand dollars for a ready-made plane, there is another way open by which he may become an aviator, and that is to *build his own!* This method does not require a great amount of money at the outset as he may purchase the material as the work progresses.

The best way to begin building your plane is to get started. The success of the ship will depend entirely on you and your efforts. Don't stand around and talk about it all your life, because your neighbor will beat you to it and have his finished while you are still discussing wing curves. A sport plane can be successfully built at home, but don't take too much "local" advice as an airplane is governed by certain well defined laws

Remember, there are as many different opinions on aircraft design as there are stars in the skies in which they fly. One design is good for one type of craft, while another type would call for an entirely different design. We do not hitch a race horse to a plow, neither do we expect an elephant to sing. Such absurdities, however, are really expected in regard to aircraft if you will only listen to so-called "advice."

Some of the boys in their haste to fly, have constructed weird looking vehicles with all the ear marks of mystery that the layman expects to find in an airplane. Let me tell you right here and now that mysterious looks and freak designs are not at all essential in modern airplane construction.

The sturdy neat construction afforded by the stick-and-wire type chosen by the designer is shown in this informative picture. Note the manner in which the fittings at the forward end of the fuselage concentrate the strains of the struts, fuselage wires, and landing gear.

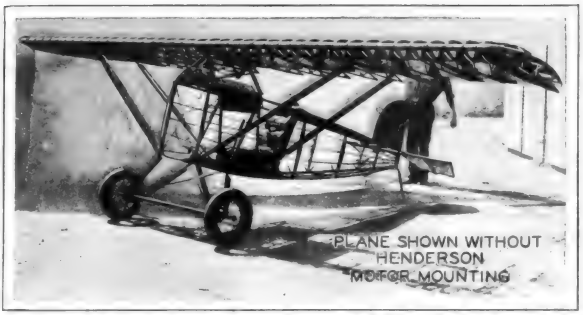
The human race stayed on the ground with the rest of the creeping and crawling things for thousands of years simply because it did not know *how* to fly. Humans thought of flying and wanted to fly from the beginning of time, but they did not possess the intelligence nor the facilities to construct a contrivance that would carry them through the air like the birds they envied.

As a result of this long wait to get into the air, the average man of today, although he wouldn't admit it, still surrounds an airplane with a shroud of mystery. He wonders how and why it sustains itself in midair.

There is no wonderment in it to an aircraft engineer, because he knows, even while the plans are still on the table whether or not the plane will fly.

He knows that a certain weight properly supported by a lifting surface and carried through the air at a certain velocity, with proper control, is the sum and substance of the description of an airplane.

He knows that if the lifting surface is not sufficient to sustain the weight at a certain velocity, he must increase this speed by the installation of a more powerful motor. The small boy with his kite has the same problem; the faster he runs, the higher it climbs and the more weight it will carry—when he slows down, the kite drops back to the ground helpless.



The sturdy neat construction of the prettily proportioned Russel sport monoplane is shown by this skeleton view. The weights are not hung so far below the wing that there is excessive pendulum stability. Ample depth and thickness to the wing spars gives one an easy sense of security in the knowledge that the ship can be called upon to do anything at any time without fear of failure. Short tail length with good area makes for quickness and ease of control. With the weight of the gas tank in the pilot's lap, so to speak, the machine behaves like the war scouts of 10 years ago.

The laws that govern the kite govern the actions of the airplane and you may call the string the motor, the wooden sticks the fuselage, the paper the wings, and the tail the rudder. You will understand from this that men understood the principle of an airplane long before they ever saw one, as kites have been flown for hundreds of years.

Design

In designing a sport plane, we must deviate, to a certain extent, from the conventional method of designing a commercial plane. In the latter case the engineer is given the requirements of the proposed craft and he designs the plane to meet these requirements. He is told that it must carry so many passengers at so many miles per hour, at a certain cost per mile, etc.

Armed with this information, he determines the approximate weight of the plane loaded, ready to take the air. He designs a wing that will carry this load at the required s p e e d. He then calculates the amount of horsepower necessary to pull the plane through the air at this speed and orders a motor of this horsepower rating.

This is merely mentioned to show that in commercial work the plane is designed first, and then a motor is mounted in the plane that is capable of giving it the required performance.

In our case we have no large assortment of motors to pick from and consequently we choose the *motor first* and design a plane that the motor can efficiently handle.

We cannot be too particular in regard to performance, unless we want to spend a large amount of money for a comparatively high powered motor. At the present time, there are, unfortunately, very few motors that can be used successfully in sport planes. The Anzani, Szekely, LeBlond, are the most popular of modern, light plane motors. Any of these motors will give a well designed sport plane a remarkable performance, comparing favorably with the finest of commercial ships. There is, however, an insurmountable obstacle in the path of the average amateur desiring such performance; and that is the cost of the motor.

The use of any of these motors, in a sport plane would make the total cost of the plane exceed the limits which the amateur can afford to pay.

While we may sacrifice high speed and fancy performance, without getting into difficulties, there are a few features that we cannot afford to overlook in choosing a motor for our plane. These are, dependability, weight, and sufficient horsepower to safely carry the plane through the air. In

Ruggedness Reflected in Heavy Spars and Wing Ribs

This fine photo shows the details of the way in which the wing is mounted on the plates on the N strut cabane. Notice also the sturdiness of the leading edge and of the ribs' construction.

order to arrive at a conclusion on the dependability of the motor, we must have a record of its past performance. If we know its weight, its ability to handle a plane can easily be figured. Adding low price to the above mentioned qualifications, we find that the little Henderson four cylinder motorcycle motor stands out as the logical choice of the amateur builder.

Its dependability is well known and its weight and horsepower meets the requirements of the average single seater sport plane very nicely. It weighs 125 lbs. when converted for airplane use and develops 23 horsepower, giving it a pound per horsepower ratio of 5 plus.

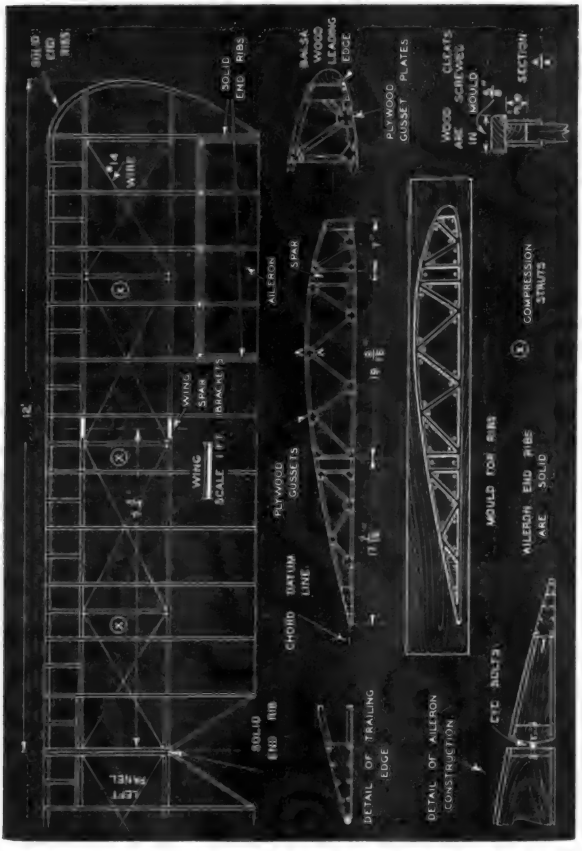
In order to use it in a sport plane, extensive alterations must be made. The transmission case must be cut away, the oiling system changed, a large thrust bearing must be installed on the crankshaft to take the propeller thrust. Special main bearings replace the old ones, and a few other minor operations complete the job. It is not advisable for the amateur to attempt to do this work himself as it is a job for a first class machinist with the proper tools. A number of aircraft supply houses are now selling these motors, *ready for use* with all the changes made and their prices range from $225.00 up to $350.00.

It being a very efficient motor, one gets the benefit of low fuel consumption—some claim as high as thirty-five to forty miles on a gallon of gas. Last, but not least, in the eyes of the amateur, it doesn't cost a fortune to buy it. This is the line of reasoning that resulted in its choice for use in the sport plane we will describe for you.

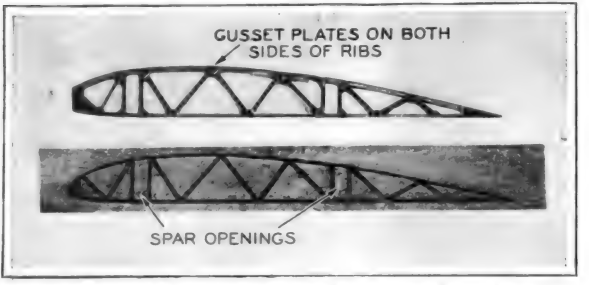
Having reached a decision on the motor, we must now begin the design of the plane. First of all, we must estimate the total weight of the plane, loaded ready to take the air. This must be done in order to arrive at some conclusion on wing design. We find that the average commercial plane has a wing loading of 10 lbs. per square foot. This means that for every 10 lbs. of load there is one square foot of wing surface to support it. These figures vary according to the type of plane.

Fast high powered racing planes have a very heavy wing loading, while the lower

Wing Panel, Wing Rib and Rib Jig Details Shown Below



The wing panel may be built in either 11-foot or 12-foot length without altering the position of the strut fittings, which are constructed in the same way the Heath Parasol fittings were constructed as described in last issue.



By making a jig the wing ribs can be easily measured, cut, and nailed.

powered machines have a light wing loading. It will be readily understood that the faster a supporting surface is pulled through the air, the greater weight or load it will sustain. Just as your old kite sank to the ground when you stopped running with it, so will your plane sink, unless you have sufficient wing surface to support it at the speed your motor is capable of carrying it. Generally speaking, the rule is, high power, heavy wing loading; low power, light wing loading.

After carefully studying the characteristics and specifications of several successful commercial planes, we decide that we will build a monoplane. We sum up the weights of the various units of the proposed plane and find that we must carry 475 lbs. through the air. This is found by adding to the known weight of the motor and propeller, the estimated weight of the fuselage, motor mounting, pilot, empennage or tail assembly, landing gear, etc.

To all this, we add ¾ of a pound for each foot of wing surface as we learn from the data at hand, that this is the figure on wing structure weights. From these figures we learn that in order to give our plane a wing loading of 5½ lbs. to the square foot, we must construct a wing containing 88 sq. ft.

We know that an airfoil, to be efficient, must be at least five times greater in width than it is in depth. This is called aspect ratio. With this in mind, we make the wing span 24 ft. with a 46 inch chord or depth. This gives us the required number of square feet of supporting surface for our plane.

We must now choose a suitable wing curve, from the hundreds of curves used successfully in the larger ships. Wing curve is a designation used to indicate the curvature of the wing rib in respect to its upper and lower surfaces. It is this departure from a flat surface that determines the efficiency of an airfoil. In a sport plane we must use the most efficient airfoil possible, because our horsepower per pound ratio is just a little low and of course we must make up for this to a certain extent by using a curve that will give best results at moderate speed. Our wing must combine high lift with a minimum amount of drag or resistance.

This resistance consumes a certain portion of our available horsepower and with this, we must be very economical as our supply is limited. We must also choose an airfoil that will give us *ample size spars.* The spars are the main supporting structure of the wing assembly and upon them depend the rigidity and strength of the wing. We find by investigating the characteristics of the various airfoils that the Clark Y—15 meets our requirements. With a chord of 46 inches, it gives us sufficient spar depth to withstand *any* possible strains imposed on the wing structure.

This size could be much less, if we were assured that the ship would always remain in a level flight position. The loads placed on the various units in this position, are approximately 1/5 of the strain imposed on them when the ship is pulled out of a steep dive or in inverted flight. With these hazards in mind, we must make our plane structure at least six times stronger than would be necessary if our plane always remained in a level flight position. This is called factor of safety and in our ship, we say we have a safety factor of six.

Rib Construction

With the dimensions of our wing determined and the choice of the curve made, we may now begin actual construction of the ribs. The woods used in a wing rib are invariably, spruce, mahogany, or birch. We choose spruce as we find that the strength-weight ratio is very satisfactory and is used in most all of the commercial planes. This is ordered cut to size from one of the lumber companies handling aircraft lumber.

We take a heavy board of gum or similar wood and cut out the design of the rib in its surface, the depth of the rib as shown in the blueprint on the wing details. This is called our mould and by using this method of manufacture, we know that each rib will be uniform in size. We cut our rib stock the proper lengths and lay them in their respective grooves in the mould.

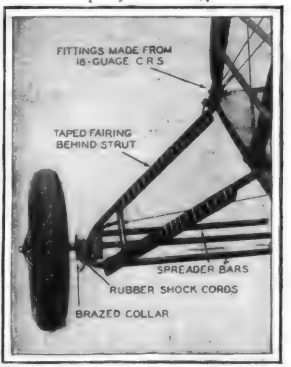
After applying generous portions of casein glue to the joints, we further provide for the rigidity of the rib by nailing and glueing a gusset plate of birch plywood over each joint. We then lift the assembly out of the mould and repeat the operation on the other side. The ribs are then hung up to air dry in a warm dry room.

After the glue is set, moisture does not affect it.

To insure yourself against moisture damage, use only a good grade of casein glue. Other glues are not as satisfactory as casein. It is made ready for use by merely adding cold water and mixing thoroughly.

The spars are provided for at 16 and 60 per cent of the rib chord using the leading edge as a datum line. As the center of pressure will be at approximately 32% of the chord, this spar arrangement will properly distribute the load. The center

Close-up of Landing Gear



The Russel method of constructing the undercarriage is plainly shown in this excellent view of the right wheel and shock absorber assembly. Note the liberal use of welded joints, which have come to be regarded as unusually safe.

of pressure is the point on the wing at which the greatest lift occurs at ordinary flight positions.

Spar Construction

After carefully studying tables giving the strength of various woods used in aircraft, we decide that our spars shall be 7/8-inch thick and of course our wing curve design determines the depth, which is, 6 inches for the front and 4¾ inches for the rear spar. The upper and lower edges are cut at a slight angle in order to make them fit snugly against the cap strips. We do not hollow out the spar as the generous depth makes them exceptionally rigid without increasing the width which necessitates routing in order to decrease weight. To give the wing sufficient strength to withstand the drag imposed on it at high speeds, "drag-bracing" is incorporated. This entails the use of compression ribs. These are made of 5/16 by 2 inch spruce struts spaced 33 inches apart. A pair is used at each station. The drag wires are made of No. 14 steel wire and form an X between each set of compression ribs. Four inch turnbuckles are employed to keep the wing

in alignment and these are fastened to fittings made of 16 gauge steel. These fittings are placed at the ends of the compression ribs and wood screws hold them in position.

Ailerons

The ailerons come next to our attention and we find from data obtained from commercial airplane specifications that our plane will require 8 sq. ft. of lateral control surface. This is divided by two which gives us 4 sq. ft. in each wing. Aspect ratio is again required in this unit and this consideration results in the placing of the leading edge of the aileron at 74% of the chord of the wing using the leading edge of the wing as a datum line. The design of the spars and ribs for the aileron follows closely that of the main ribs and spars as shown in the wing blueprint. Eye bolts are used for the aileron hinges, three being used on each aileron. These bolts may be obtained from any of the supply houses, such as Heath Airplane Co., 1727 Sedgwick St., Chicago, Ill., or Marvin Northrop, 730 Washington, Minneapolis, Minn.

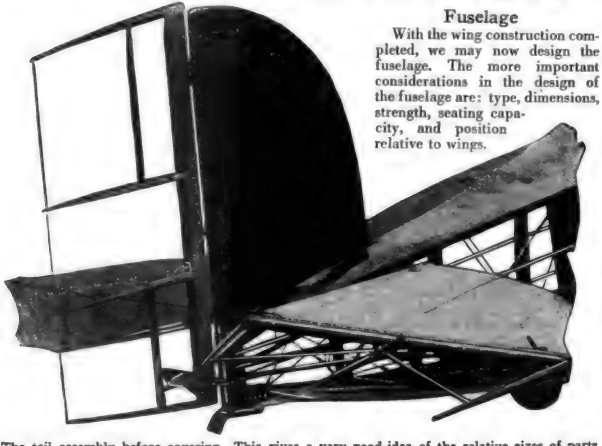
Wing Assembly

When the ribs are completed they are slipped over the spars to their respective positions. The cap strips are then nailed and glued to the spars using brass nails or screws. With the main ribs in place, the nose ribs may now be installed between each rib forward of the front spar. These are to give the leading edge fabric greater supporting surface which is necessary due to the excessive pressure existing at this point in flight. The leading edge consisting of a piece of Balsa wood 11 ft. long may now be butted against the ribs.

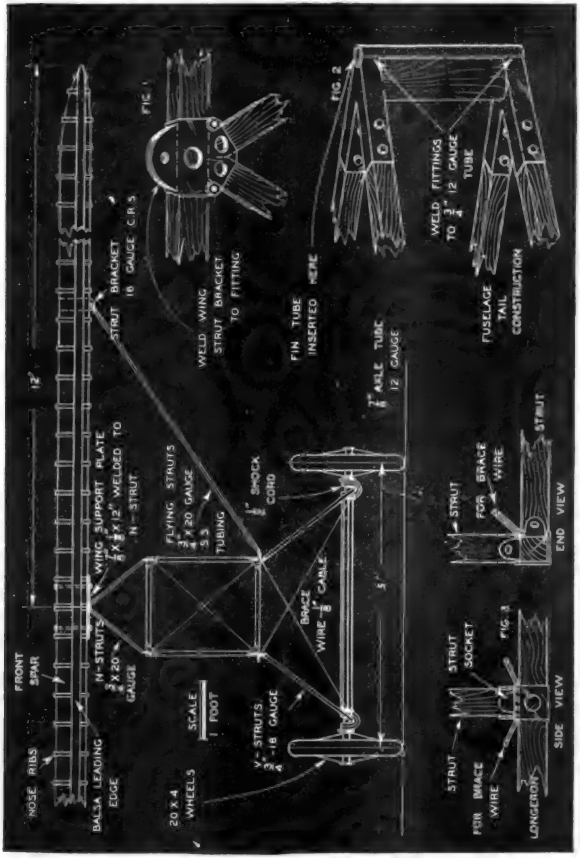
This is secured by glue, screw or nails and by continuing the reinforcing tape over the cap strips down over the leading edge and under the rib back toward the trailing edge. This gives the leading edge a very strong footing and insures the clean cut lines so desirable in the wing structure, especially at the leading edge. Any variation from the designed shape of the rib causes undue strains at that particular point and also reflects on the builder's neatness. Our trailing edge is made of No. 14 steel wire which is held to the ribs by small clips brazed to the wire and nailed to the rib.

Fuselage

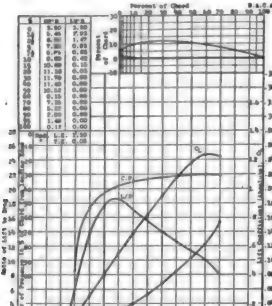
With the wing construction completed, we may now design the fuselage. The more important considerations in the design of the fuselage are: type, dimensions, strength, seating capacity, and position relative to wings.



The tail assembly before covering. This gives a very good idea of the relative sizes of parts and the way the wires are anchored. Note the wire trailing edge of the rudder.



The fitting at the N struts is shown in this print, as well as the prop end view of the entire ship. By scaling the drawing all dimensions not shown can be approximated. See text for sizes of parts.



The dimensions and characteristics of the Clark Y wing curve are here given as furnished by the National Advisory Committee on Aeronautics. The heights at different chord percentages are given as fractions of the chord. Note that the bottom is flat after passing the 20% ordinate. This makes for simplicity in building.

There are a number of distinct types of fuselage construction, the most popular being steel tube, stick and wire, and monocoque. Steel tubing is by far the best and is used in practically all of the modern commercial planes. It presents difficulties, however, to the sport plane builder due to the large amount of welding necessary. We have no welding outfit and can't afford to spend fifty or seventy dollars to have it done so we must choose a method and materials of construction that do not require this professional touch. Monocoque is entirely out of the realms of possibility as far as we are concerned due to the fact that it consists mainly of properly moulding or wrapping plywood over cross sections or bulk-heads, thus forming the fuselage. This requires great skill and experience in handling plywood and as we have neither of these, we abandon this method in favor of the old, reliable stick and wire type.

In this type, wood is used to take the compression while high grade steel wire takes the tension strains. Its constructional difficulties are limited, the important thing to remember is to keep the *vertical* members straight or *parallel to the forces of compression.*

With a type chosen, we can now deliberate on the dimensions of the fuselage. We know it must be large enough to properly seat the pilot, shielding him as much as possible from the propeller blast. We cannot go to extremes in this respect, however, as we cut off the vision of the pilot as well as increase the weight unnecessarily. We find after using our pencil a while and making a few practical experiments, that we will need a fuselage structure measuring 25 in. deep by 19 in. wide. This depth of course, in itself, would not shield the pilot, but with the addition of the cowling or superstructure used to house the gas tank, and give the fuselage a stream line form, we find it serves our purpose very nicely.

Length is the next consideration and this we learn must be determined by the wing chord and span. The fuselage in one of its various functions acts as a lever because of the rear control surfaces. We know that these surfaces change the attitude of the ship in relation to its flight path. The elevators nose her up or down while the rudder pulls her to the right or left. We know that the longer a lever is, the less force it takes to lift a certain load. This is the principle we find involved in the relationship of the fuselage length and the tail surface area. From this we gather that the longer our fuselage is, the less tail surface we will require and vice versa. In studying the data on successful ships, we learn that the average fuselage is from two to two and one half times the chord length. This is using the center of gravity and tail post as datum lines.

Armed with this knowledge we decide to make our fuselage 124 in. long. This gives us approximately two chord lengths from the center of gravity to the tail post. This distance does not include the motor mounting. This is left for later consideration, when we find the center of gravity. The fuselage terminates a few inches forward of the landing gear position.

At this point we install brackets to which

we may attach our motor mounting. This type of structure facilitates installation of different motors and in taking our original motor off for repairs. All that is necessary in order to dismount the motor is to remove the connection bolts and brace wires. This does not disturb the fuselage proper and makes it easy to change motors in case you wish to increase the power later on.

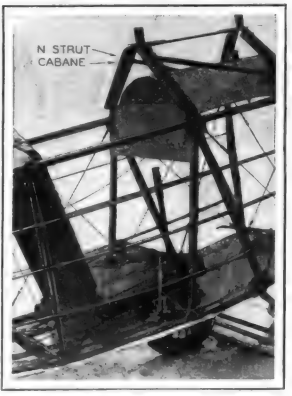
Keeping strength:—weight ratios in mind, we make the longerons of ash and spruce, splicing them. The ash in the forward part amply takes care of the greater strains encountered by this section. By using spruce for the rear longerons, we economize on weight and still have the required strength. They are spliced with a scarf joint which consists of cutting the spars diagonally for a distance of nine inches, applying casein glue and wrapping the entire joint with strong cord. Cover the joint with a couple of coats of varnish.

The longerons are $\frac{7}{8}$ x $\frac{7}{8}$ and the struts of like dimensions. The struts are tapered from the center toward the ends. The forward struts are made $\frac{7}{8}$ x $1\frac{1}{4}$ to take care of the extra strains caused by the wing strut connections. By referring to the blueprints you will get a clearer idea of the general fuselage construction. These plans are drawn to scale and by laying a ruler on them, you can easily determine the dimensions of the various members. Use No. 14 standard steel wire for diagonal bracing with three and three-quarter inch turnbuckles. Make the fittings of sheet steel, using the various gauges as shown in the illustrations. These fittings are all bent cold and cut out with a hack saw and cold chisel. Use a file for making the edges uniform and smooth.

We now find that we must call in the services of a welder in making some of the fittings. We make sure we get one who knows his business as the strength of the whole structure depends on his welding ability.

Tail Surfaces

Tail surfaces now come to our attention and we make the vertical fin first. In this we use $\frac{1}{4}$ in. 20 gauge steel tubing for the leading edge mounting it in a socket placed on the fuselage horizontal strut. The trailing edge of the fin or tail post is made of $\frac{3}{4}$ in. 20 gauge steel tubing which is inserted in the tube provided for this purpose at the extreme rear of the fuselage proper. The ribs are made of spruce in the conventional I beam section and are supported by means of small clips welded to the tubing.



Showing pilot's seat and N-strut cabane before wing is mounted.

The stabilizer is made next and the same general constructional features prevail as in the fin. This is also true of the elevators and rudder. The tubing or leading edge of the stabilizer incorporates a bracket with an elongated slot which is fastened to a bolt in the vertical strut of the fuselage permitting adjustment of the stabilizer.

The trailing edge of the stabilizer is made of 1 in. by $1\frac{1}{4}$ in. spruce and rests on top of the longerons. The ribs are the same as used in the fins. The elevator front spar is made of $\frac{3}{4}$ in. 22 gauge steel tubing and operates off the rear stabilizer spar by means of strap hinges. See profile and plan blueprint.

In the rudder we use a piece of spruce $\frac{3}{4}$ in. by $1\frac{3}{4}$ in. for the front spar and it operates off the tail post using hinges similar to those used on the elevator. The other details are similar to those in the fin.

(Continued on Page 183)

Radio "Ear" Takes Soundings of Sea Depth

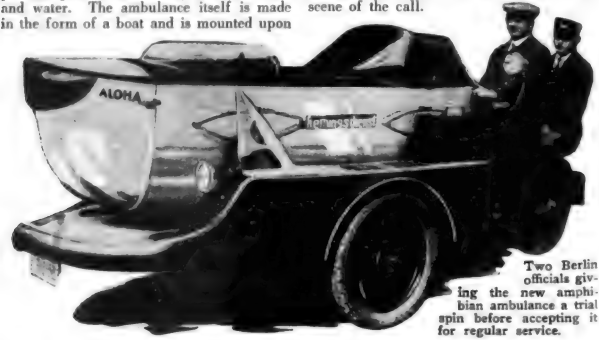
Dr. Herbert Dorsay is shown examining his new depth measuring instrument, Fathometer.

RADIO equipment was employed in a new usage by Dr. Herbert G. Dorsay of the Coast and Geodetic Survey in Washington, when he invented a new depth measuring instrument for mapping and charting under-surface regions of the sea. Radio reception of sound waves is the basis of the Fathometer, as the new invention is called. A small bomb is thrown overboard which explodes upon striking the water. The instrument is tuned to receive the reaction of the explosive sound on water, which strikes the bottom of the ocean and echoes back into the "ear" of the device. The time required for the echo's return is measured by a set of delicate radio meters. From these computations the depth of the ocean at that spot may be determined.

Measuring ocean depths with the old time lead is slow and inaccurate. The use of the new Fathometer in mapping and charting work is a great step in advance, since it is accurate to a fine degree and has the speed of sound. Radio has made possible the measurement of sound waves to a fine degree of accuracy.

NEW AMBULANCE TRAVELS ON EITHER LAND OR WATER

BERLIN recently added a strange piece of equipment to its police ambulance service in the form of an amphibian ambulance. Tests conducted with the new amphibian proved satisfactory on both land and water. The ambulance itself is made in the form of a boat and is mounted upon a motor-tractor platform. The boat can be pushed by motor to the banks of a river or lake and slid into the water from the specially constructed platform and being fitted with its own engine can then speed to the scene of the call.



Two Berlin officials giving the new amphibian ambulance a trial spin before accepting it for regular service.

Plates Made From Paper Will Cut Printing Costs

PRINTING plates which are made from a paper base and which combine great strength with lightness and flexibility are expected to greatly reduce printing costs. As illustrated in the photo above, the paper plates will bend into any desired shape; all that is necessary to print from them is to mount them on a wooden base to make them the same height as printing type.

No casting in metal is necessary, as is the case with stereotype mats which have long been common in newspaper offices. The inventor is Fred C. Goldenbaum, who perfected the process after years of study of the compositions from which combs and phonograph records are made. The paper printing plates are so light that they can be sent inexpensively through the mail as first class matter, and they will withstand rough handling better than metal plates.

PUTS "FIZZ" IN DRINKS

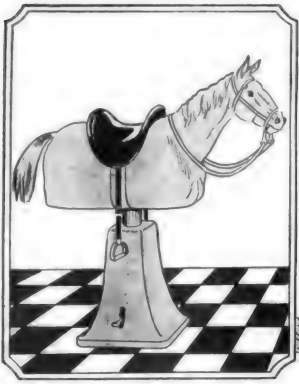
A HANDY kitchen attachment which produces a steady stream of sparkling bubbles to add life to ginger ale and carbonated drinks has recently been put on the market. It is also a handy mixer and serves as a stopper to keep bottled drinks from becoming flat. In shape it is designed to fit ordinary beverage bottles. As the photograph shows, the device is provided with a hollowed screw point which is punched through the bottle cap. When the bottle is shaken the imprisoned gases effervesce inside the bottle, and by simply pressing the valve on top the bubbling drink is directed into a glass through the escape tube in the side of the "fizzer."

SPIRAL PARKING GARAGE

A CIRCULAR garage for parking cars which somewhat resembles a locomotive roundhouse has been invented by R. G. Livingstone of London. The garage can be of as many stories as is desired, for the floor slopes upward spirally and the stalls for the cars are provided in the side walls. Cars enter at the ground floor level and drive upward until they reach their parking space. The advantage of the spiral design is that it makes the most effective use of the space available.

R. G. Livingstone studies a cardboard model of the spiral garage he has invented for parking automobiles.

Modern Mechanics YOUR
PRESENTS



Want to make a million? Study these ideas which Modern Mechanics here presents to its readers; they're real money makers!

NOBODY but a barber can appreciate how difficult it is to trim the hair of a squirming, restless youngster who is interested in everything else in the world except having his hair cut. Short of grasping the child's hair with one hand and manipulating the scissors with the other—which is not wholly a satisfactory method, especially if the youngster's mother be looking on—there is nothing much that the barber can do about it except to make the best of things. One happy solution to the problem would be the design of a rocking horse barber chair like that pictured above.

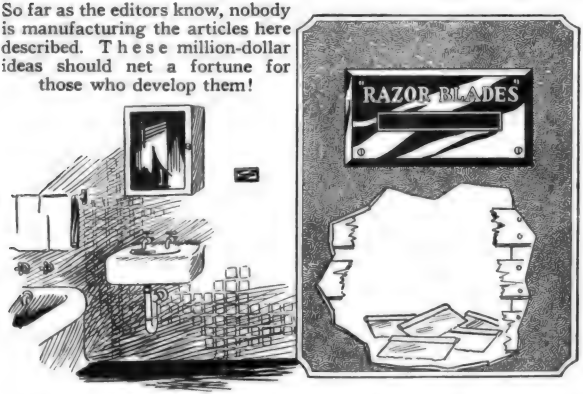
As an opportunity for a young man to develop a profitable manufacturing business of his own, the idea of developing a barber chair for children offers interesting possibilities. So far as is known there is no company at present making hobby horse chairs of the type shown in the drawings. Such chairs could either be sold outright to barber shops, or leased at a small rental.

At a manufacturing cost which would range around $100 per chair on a quantity basis, the units should rent easily for $25 per year, netting a handsome return. At this moderate cost there are few barber shops which would not find the rental of at least one such chair a good business proposition. The expense of maintaining the chairs, together with selling expense and overhead costs, should not exceed $10 per year and would probably run much lower than that, especially if chairs were leased on a five-year or other long time basis. Bearing in mind that barber shops are almost as numerous as grocery stores, and that there are upwards of 200,000 of them in the United States, it can be seen that the field is a large one.

Suppose that one succeeded in renting a chair to one out of four shops. This would bring in a total yearly income of $1,250,000. At a cost of $10 per chair, or $500,000, this would leave $750,000 as net income. To manufacture 50,000 chairs would cost about $5,000,000, or 15% return on investment—and in addition to that, the chairs would be paid for and returning a larger profit the second year.

OPPORTUNITY

So far as the editors know, nobody is manufacturing the articles here described. These million-dollar ideas should net a fortune for those who develop them!



Bathroom Chute for Old Razor Blades

HOW to dispose of old razor blades—that is a question which seems a bit humorous at first glance, considering the frequency with which it has been dealt with in newspaper comic sections, but in reality it is an annoying domestic problem, especially in the home where there are children about.

An opportunity to establish a paying business of one's own, without the need of investing much money, is afforded in the manufacture and sale of a device like that shown above, which is a convenient solution to the razor blade problem. All that is necessary is a brass or other polished metal plate, beveled at the edges and provided with a slot large enough to accommodate a blade. In less than five minutes this plate can be attached to the bathroom wall, giving a permanent means of disposal of old blades. A hole slightly smaller than the dimensions of the plate is cut through the wall, exposing the dead space between the lath and the outside walls of the house. The plate is then screwed in place and when blades are pushed through the slot they drop down to the foundations of the house, where they are permanently out of the way.

The metal plate is inexpensive to manufacture. Anyone going into the business on a large scale would probably purchase machinery such as stamping presses and dies and make the plates for himself. Any established manufacturer of metal goods, however, will be in a position to make these plates at reasonable prices even in small quantities. The cost will of course vary with the quality of metal desired and the elaborateness of the design, but a fair average price would be around fifty cents. The selling price would be not less than $2 and might range up to $3 or $4 including installation. If the price were set higher than this latter figure, the number of sales would very likely be cut down materially, because in the final analysis the disposal of old blades is more of a nuisance than a pressing problem.

Who Flew FIRST?

By MAJOR H. H. ARNOLD

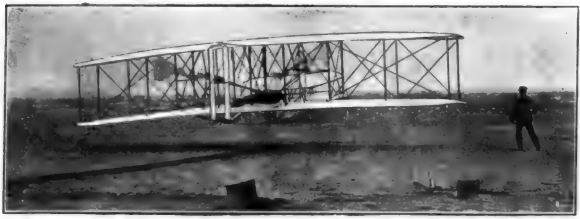
The Wright brothers, of course—this is the accepted answer to the question asked in our title. Yet the original Wright plane rests in London, the object of a dispute between Orville Wright and the Smithsonian Institute. Major Arnold, a personal friend of Orville Wright, gives us the fascinating inside story of this historic disagreement.

ON DECEMBER 17, 1903, Wilbur and Orville Wright made four flights in a heavier-than-air machine at Kitty Hawk, North Carolina. The airplane was equipped with a small 12 H. P. engine. It was quite fragile when compared with the planes of today—so fragile, in fact, that later in the day a gust of wind overturned it and completely wrecked it.

However, that machine was the first man-carrying airplane to leave the ground under its own power. On Dec. 14, 1903, Wilbur Wright remained in the air for about 3½ seconds and covered a distance of 100 feet. On Dec. 17, Orville made two flights, the longest being of 15 seconds duration, and covering a distance of 200 feet. Wilbur also made two flights, in one of which he remained in the air for 57 seconds and flew a distance of 850 feet. Today that first of all successful airplanes is in the South Kensington Museum, London. Why is it not in a museum in the United States?

To get at the basic facts connected with this unfortunate state of affairs it is necessary to go back a few years and review some of the early aviation experiments and tests. There were two schools of thought during those early days of aviation. In one, followed by Professor S. P. Langley, of

This picture, reproduced from an old photograph taken shortly after the Wrights succeeded in making the first flight in a motor-driven plane, shows Orville, Katherine, and Wilbur Wright. Katherine Wright was a sister of the inventors and her steady encouragement inspired the brothers to carry on their experiments to success.



The first successful airplane flight! Accomplished by Wilbur Wright at Kitty Hawk, N. C., December 17, 1903. Note the launching rail on which the plane rode while gaining momentum for the take-off.

the Smithsonian Institute, Sir Hiram Maxim, and others, attempts were made to produce at the outset power driven airplanes. In the other, followed by Lilienthal, Chanute, the Wrights and others, attempts were made to first master the glider and then install an engine for actual flights.

Prof. Langley started his experiments in 1895. On May 6, 1896, one of his models flew across the Potomac for a distance of three-quarters of a mile. His efforts seemed to have such a good chance of success that Congress appropriated $100,000 for his use. Langley constructed a full sized plane which was ready for test on Oct. 7, 1903.

The machine was called an airdrome, for lack of a better name. It was erected on a track on top of a house boat. The flight was to be made across the Potomac. The pilot took his seat, the plane was released, but contrary to expectations it tumbled off the end of the track into the water.

This machine was reconstructed and given a second test on Dec. 8, 1903. Once again the airdrome nosed over into the water. The model had made a remarkable flight but the full sized plane was apparently a failure. Langley was condemned by the press of the country for his waste of public funds. His pioneering in aviation was over, for he died a short time later—a heart-broken man.

It was not until October, 1900, that the Wright brothers arrived at Kitty Hawk for their first gliding experiments. They gave Lilienthal the credit of being the greatest of all aerial scientific investigators up to that time. Wilbur Wright stated, "Of all who attacked the flying problem in the nineteenth century, Otto Lilienthal was easily the most important. * * * As a scientific investigator none of his contemporaries was his equal."

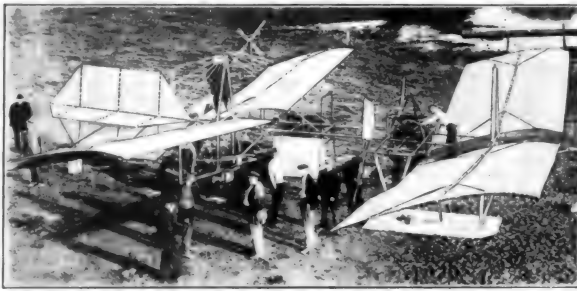
However, even with Lilienthal's data, the Wrights could not at first make successful gliders. They were forced to start from the bottom and secure their own rules and principles. At first they endeavored to use the glider as a kite with a man aboard, but soon gave up the idea and followed the established precedent of gliding down hills into the wind.

During the fall of 1902 they made over 1,000 gliding flights. They were convinced that they could now handle the plane in the air. They were ready to install an engine and transform the glider into an airplane. The following year they made the successful airplane flights referred to above. Thus, but a few days after the failure of Langley's machine, the Wrights had produced the first successful airplane.

The Wrights were quite candid about the lack of faith they had in Langley's experi-

The Langley Tandem monoplane in flight near Hammondsport, N. Y. A few alterations from the original design and the installation of an efficient motor made it airworthy.

Langley Airdrome, Built before Wright Plane, Failed to Fly Until



Workmen completing alterations on the Langley airdrome, or tandem monoplane, preparatory to its flight pictured on page 71. This machine, invented by Samuel Pierpont Langley, was placarded by the Smithsonian Institute as being the first heavier-than-air craft capable of sustained free flight, a description to which Orville Wright objected.

ments, for in June, 1903, prior to their first successful flight, Orville Wright wrote to an aviation fan:

> "You were inquiring some time ago about Langley's 'Experiments in Aerodynamics.' We do not think that it would pay you to buy this. In fact, we place very little confidence in the work. * * *"

Thus any connection between the Wright and Langley tests is once and for all thrown into the discard.

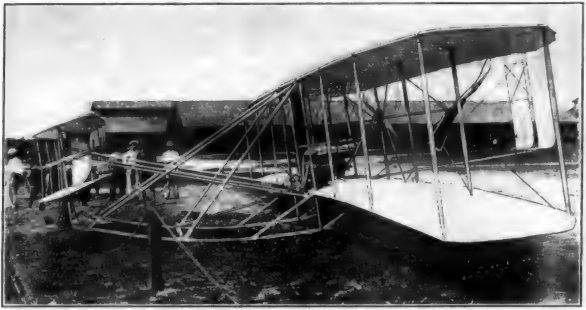
It was not until 1910 that the Smithsonian Institute suggested that a Wright airplane be placed in the Museum for exhibition. Then followed a correspondence which revealed the facts that the original Wright plane was not exactly what was desired as an exhibit, a *quarter-sized model* of the *1908, plane* would be most desirable; if there was any radical difference between the original plane of 1903 and the 1908 plane, then a *quarter-sized model* of the original one would be acceptable. It was further stated by Doctor Walcott that there would also be on exhibition the *full-sized Langley plane,* together with three Langley models.

The Wright brothers could not reconcile themselves to placing a quarter-sized model of their plane, which had actually flown, on exhibition with a full-sized plane of Langley's together with three models of Langley's planes. The full-sized Langley plane had never flown and the models had never been built to full size. The impression which would be created, from the viewpoint of the Wrights, was that Langley's plane had been constructed in 1903 whereas theirs had not been produced until 1908.

Such was the condition of affairs in 1914 when the Langley plane was sent to the Curtiss Company at Hammondsport, N. Y.

For a long time there was considerable discussion as to exactly what changes had been made on the Langley plane before it made its flights on June 2, 1914. In a report of the National Museum for 1914, it was stated that successful flights were made "*without modification.*" Orville Wright enumerates three or four vital changes and states that he can name at least twenty changes. He says, furthermore, that some of the changes made spelled the difference between successful flights of the plane and

The Wright airplane undergoing a government test. Notice the launching device in the background. A falling weight pulls a cable which gives the plane a swift start.



The Wright airplane of 1908. Notice the chain drive employed in turning the propellers. The gasoline tank and motor are mounted on the lower wing. According to modern construction, the plane seems turned around—the rudder shown at the extreme left of the picture, which looks like the tail assembly, is actually the nose of the plane, which is pointing towards the left.

failure of the machine to fly. The movement of certain trussing to change the location of the centre of pressure and the changing of the camber of the wings from 1 to 12 to the ratio 1 to 18 would most assuredly affect the flying qualities of any airplane.

Orville Wright has always said that Dr. Langley would never have countenanced tests of the character of those made at Hammondsport. He further said that he could not with any confidence or self-respect turn his machine over to an institution which had already allowed Dr. Langley's to be tampered with and lent itself to a systematic perversion of facts.

Accordingly those who knew Mr. Wright well were not surprised when he announced in 1925 that the Kitty Hawk airplane was going to London. This statement again reopened the controversy. The label on the Langley machine had been changed several times.

In 1928 the case was again opened after the original Wright plane had been sent to England. The present director of the Smithsonian Institute stated among other things that "if Mr. Wright will openly state in a friendly way that he appreciates that the Smithsonian Institute honestly believes that the Langley machine of 1903 was capable of sustained free flight under its own power, carrying a man, and that it now removes that public statement, not in confession of error, but in a gesture of good will for the honor of America, then I am willing to let Langley's fame stand on its merits and to reduce the Langley label to this simple statement: 'Langley Airdrome—The original Langley flying machine of 1903, restored'."

The Board of Regents of the Smithsonian Institute have investigated and reported, the label on the Langley plane has been changed, a bill has been introduced in Congress to determine which was the first successful heavier-than-air flying machine, but the historic facts are well known—the Wright plane flew and the Langley plane did not until it was reconstructed according to modern principles of aerodynamics.

In the meantime, the original Wright plane is in the British Museum, but fortunately there is a string tied to it, for Orville Wright can bring the first of all airplanes back to this country at his option. Let us hope that in the near future all of the "ands," "ifs" and "buts" will be eliminated from the labels on the Smithsonian Institute exhibits and that they will be presented according to historic facts—the Langley plane as the endeavor of a scientist, the Wright machine as the first successful airplane.

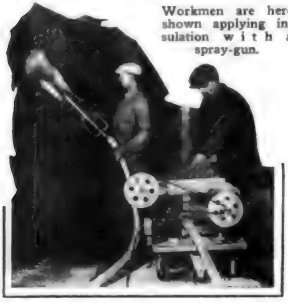
Hooked Stick on Plane Picks Up Ground Messages

The method of picking up a message by means of a hooked stick attached to the airplane fuselage is shown in the photo above.

ONE OF the new pieces of airplane equipment adopted by the British Royal Air Force is a hooked stick which is attached to the bottom of an airplane fuselage for the purpose of scooping up messages without coming to the ground. The photo at the left shows how the apparatus works. A written message is hung in a canvas bag on a line suspended between two poles. The plane then descends to within five feet of the ground, lowers the hooked stick, and gathers up the bag. This device insures perfect secrecy and helps to keep the aviator fully informed of the wishes of his superiors without making it necessary for him to land frequently.

FIREPROOF COATING

ARCHITECTS drawing plans for the latest buildings advise the use of the coating device shown in the picture below for the purpose of insulating the structure against heat and cold. The insulating material is mixed on the spot in the electrical device, which feeds the substance through a hose and blows it into every nook and cranny at high pressure. In this way the entire wall is insulated and there are no leaks or poor fitting corners where winter winds can whistle through. The insulation has the additional advantage of being fireproof. Mechanical application of liquid insulation is just another step in the development of machines which speed up the construction of modern buildings.



Workmen are here shown applying insulation with a spray-gun.

FILLING STATION FOR CIGAR LIGHTERS

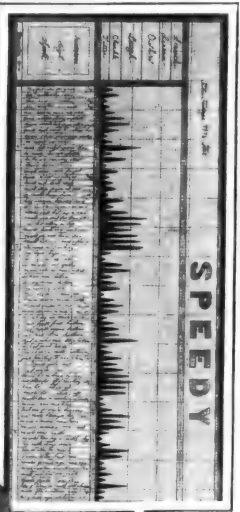
POPULARITY of cigar lighters of the portable automatic type which burn alcohol as a fuel has led to the invention of a "filling station" where empty lighters can be replenished. As shown in the photo the device is a miniature reproduction of the large size pumps used in gasoline stations. One cent is the charge for a filling. Dropping a coin in the slot permits a quantity of the fluid to pass through a drain spout when a lever is pressed. The device is entirely automatic in operation.

8-MILE TUNNEL OPENED

A TUNNEL eight miles in length, said to be the longest in the Western hemisphere, has just been opened in Washington by the Great Northern railway. Fifteen hundred men worked for three years to complete the tunnel, which lowers the mountain grade more than 500 feet and eliminates six miles of snowsheds, which are a heavy item of expense on railroad treasuries.

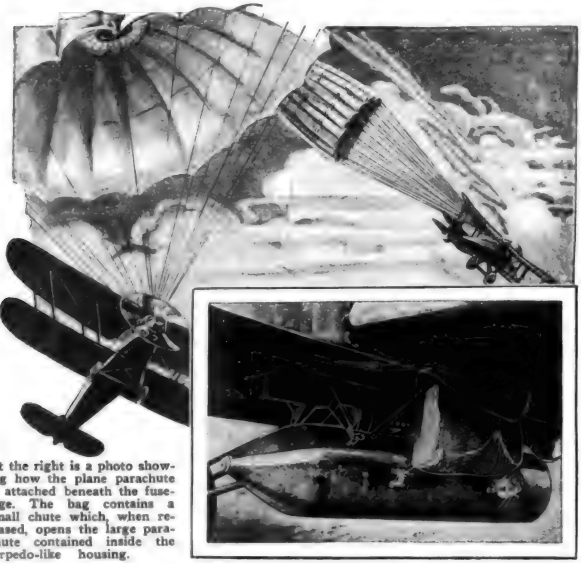
What Makes You LAUGH?

DO YOU know why you laugh when the comedian throws a squashy custard pie into the villain's face? The business of making you laugh is a very serious one—so serious that movie magnates go to great expense in analyzing the causes that arouse mirth in audiences. Harold Lloyd recently devised a "Lafograph," shown below, to decide just what gags in his comedy "Speedy" provoked the most mirth, and why. He discovered that the first big laughs come the hardest, that proper music primes the audience for laughs, that laughter is contagious and can spread from one or two individuals to an entire audience, and that everybody has a funnybone—some people responding to slapstick, others demanding subtlety in their humor.



The chart shown directly above records the length of the laughs provoked by Harold Lloyd's comedy, "Speedy." Two of the incidents which won the longest laughs are shown in the inset photos. These apparently spontaneous movie "gags" are carefully planned for their laugh-making qualities.

PARACHUTING



At the right is a photo showing how the plane parachute is attached beneath the fuselage. The bag contains a small chute which, when released, opens the large parachute contained inside the torpedo-like housing.

By MAJOR S. W. FITZGERALD

THE very first landing of a plane supported by a parachute large enough to gently carry it to earth, was made in the United States in the early spring of 1927. The experiments were conducted in California. Further tests have been made with better releasing devices and improved chutes at Wright Field, Dayton, Ohio, by the U. S. Army Air Service. Planes may now be safely parachuted to earth with entire crew sitting at ease as though nothing had happened, for the release is positive and automatic, and after reaching the ground, the pilot may release the chute so that wind will not fill it and drag the plane.

The first tests, conducted in California, under the joint auspices of Harry B. Doucett, chief aviation machinist's mate of the San Diego Naval Air Station, and H. R. Russell, maker of the Russell Lobe type parachute.

The pilot on this test was R. Carl Oelze, of the San Francisco Naval Air Station, flying a war time Curtiss JN4D or "Jenny." As shown in November MODERN MECHANICS, the chute was fitted into the rear portion of the fuselage and the supporting wires lightly taped so that they would rip when the

an ENTIRE PLANE

Successful experiments recently conducted in landing airplanes by means of a parachute, lead designers to predict that in the near future all passenger planes will be so equipped in event of accident in the air all the pilot need do will be to release the chute and float gently to earth.

release was made and support the ship by the wires which were anchored to the strut ends of the center section wing panel.

Oelze climbed his ship to an altitude of 2,500 feet, killed his motor, and making no attempt to glide, he released the chute when the plane stalled and started spinning.

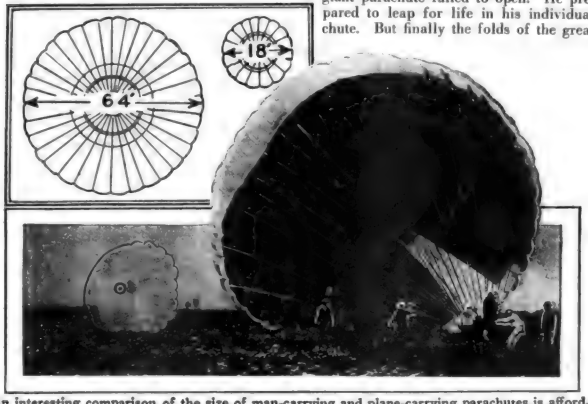
The chute fluttered, then caught with a satisfying bang, and floated the ship to earth, right side up with care.

The plane lit safely with the pilot in the cockpit. The landing gear suffered slight fracture from the pancaking.

The second test was made but a few weeks ago at Tracy, California. E. J. McKeon, San Francisco pilot of many year's experience, attached a parachute weighing 50 lbs. to the top of the wings by means of steel cables in such fashion that the pull of the cables would land the ship upright.

Not a whit fussed by the extreme danger to his life, McKeon flew the plane into the heavens as high as 4,000 feet. Whereupon he shut off his engine, released the controls, and pulled the parachute cord. At a terrific speed, the ship dove 2,000 feet, while meantime the pilot chute fluttered open.

Down again for more than 500 feet went the plane, McKeon wondering why the giant parachute failed to open. He prepared to leap for life in his individual chute. But finally the folds of the great



An interesting comparison of the size of man-carrying and plane-carrying parachutes is afforded by the photo above. The small parachute at the left, 18 feet in diameter, is large enough to carry a man. The huge parasol at the right will support an average sized airplane. The diameter of an airplane parachute runs between 64 and 85 feet. Since it is area which determines lifting power, an airplane weighing ten times as much as a man does not require a parachute ten times as large in diameter.

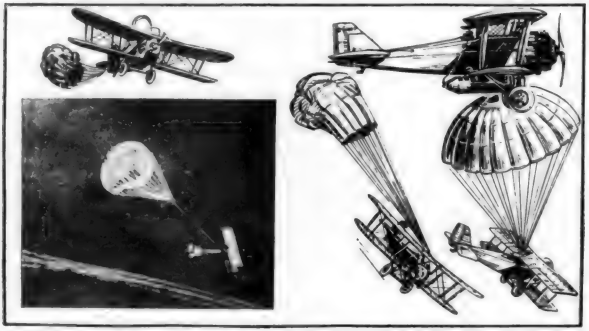
Major Edward L. Hoffman, designer of a parachute for floating planes to earth, is pictured at the right. The above view shows how his invention looks in action.

umbrella caught the wind and the plane righted itself, continuing downward at a materially decreasing speed, until it rested gently on the earth.

From the time the first experiments were conducted, both the aviators mentioned and army officers at Wright Field have been guided by the prophecies of Major General Mason M. Fitzpatrick, who said, little more than a year ago:

"The time is not far distant when parachutes capable of sustaining the weight of airplanes will be perfected and reliably used."

To that end, Major Edward L. Hoffman, Army Air Service parachute expert, has designed a parachute for floating planes to earth, which is being put through a series of tests as you read this, and which will culminate in plane chutes being installed on all aircraft in the service at some future date.



In the above photo a Jenny is shown just after making a parachute landing. The pen drawings show the various stages of a parachute opening.

Port Arthur Boasts World's Largest Grain Elevator

MILLIONS of bushels of wheat come pouring out of the great granary of midwestern Canada during the harvest season to find their way into the world's largest grain elevator at Port Arthur, Canada. Port Arthur is the Canadian farmer's outlet to the sea, being at the head of navigation of the Great Lakes. Inasmuch as the shipping season is cut short in the late fall months by ice blockades, the farmer must rush his grain to market or hold it in storage. Note the spouts in the elevator's walls.

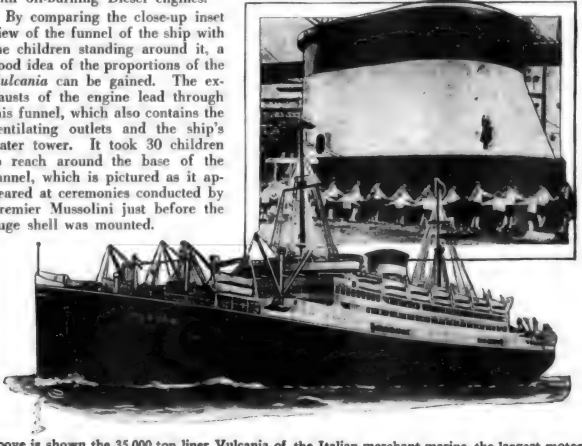
LARGEST MOTORSHIP NOW IN ITALIAN SERVICE

ITALY now has the largest motorship in the world in its merchant marine following the recent launching of the liner *Vulcania* of the Cosulich line. The new ship has a displacement of 35,000 tons. Most large ocean liners are steam driven, burning coal or oil, but the *Vulcania* is powered with oil-burning Diesel engines.

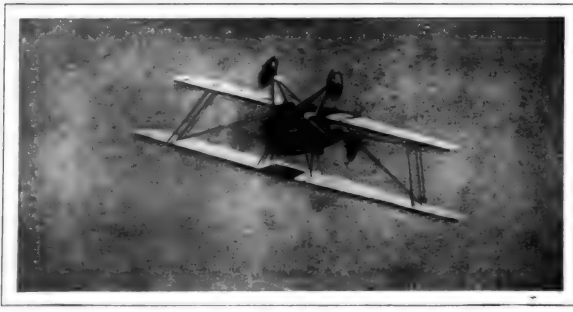
By comparing the close-up inset view of the funnel of the ship with the children standing around it, a good idea of the proportions of the *Vulcania* can be gained. The exhausts of the engine lead through this funnel, which also contains the ventilating outlets and the ship's water tower. It took 30 children to reach around the base of the funnel, which is pictured as it appeared at ceremonies conducted by Premier Mussolini just before the huge shell was mounted.

WILKINS STUDIES POLE

A LONG standing mystery of geography has been solved by the flights of Sir Hubert Wilkins in the South Polar regions. In a recent 650 mile trip south of his base at Deception Island the explorer discovered that Graham Land is not, as has been supposed, a part of the great Polar continent.



Above is shown the 35,000 ton liner Vulcania of the Italian merchant marine, the largest motor-driven ship in the world. The insert shows the huge funnel before it was installed on the ship.



Waco 10 with Wright Whirlwind motor and tapered wings in inverted flight, a stunt requiring rare coordination.

STUNT FLYING

By PILOT GENE SHANK

Pilot Gene Shank, who once held the loop-the-loop record, here tells how to Barrel Roll, loop-the-loop, side slip, and how to get ship out of a spin. Fascinating reading for embryo pilots.

HIS time you hangar hounds are goin' to be tapered off as ground kaydets because I'm goin' to tell you the stick-motions of a few stunts. Then when you climb in behind the old joystick you'll have some preconceived notion of what I'm doin', and why, when I go through the sky high evolutions for you.

But first let's take a look at the different tricks of air acrobatics. I'll tell you about the loop, the Immelman, the history of each, and what they are good for. Then we can slide along and see how they are done—you sittin' in the stern cockpit an' ine at the stick at the dual up front. You have to learn in the rear cockpit, you know, so as to get the feel of the ship. That's why I fly dual up front.

To begin with, let's look at the loop. I can speak with a little authority on this because I set the first real honest-to-goodness quantity-measure loop-the-loop record last year. Went up one afternoon in a Waco nine, OX5 motor, and slid around the inside of the barrel till I ran out of gas. Bein' which condition of the motor, I decided not to loop any more, and came down. About 561 times—that's what they told me. I lost count.

Speed Holman holds the record now. This lanky pal of mine figgered all he needed was more fuel and a total lack of appetite to go better than a thousand. He was right. He did it about a week later.

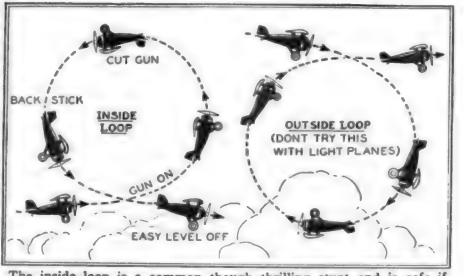
Not to be outdone because Americans had set up looping on a good old-fashioned quantity basis, a Frenchman went up to 1,400 some odd few days after Speed came down.

It made Speed sore. I figgered I didn't want any more than the glory of being the

first to start the ball rolling, as it is only a case of hanging on to the stick and to your lunch till the ship runs out of gas. But Speed is a competitive cuss, and an angel from hell when he's in an airplane, so he went up one day and did flip flops till the sun went down. I lost count. Way over the French mark, though.

So y'see, I have been around a little. And this looping stunt isn't difficult after you get used to it. It is a good war time and military maneuver, and holds the crowds breathless at county fairs. I guess they figure you will spill out and get badly scattered as you go over the top. But loops to the fellow who is doin' 'em are pretty much like straight flying. The world seems to go around and around crazy like, while you just bat along as though you were pretty much flying straight away.

To loop, the ship is dived to gain speed. At the same time it is dived the motor is cut so that it does not speed up measurably. Then as the stick is pulled slowly way back, the motor is gunned wide out. When the world is standing upside down, the gun is cut to little better than idling speed. The stick is straightened up a bit, so that when she regains diving speed you will have something left to pull her back with.



The inside loop is a common though thrilling stunt and is safe if gently maneuvered. The outside loop is extremely difficult and only a few have dared it.

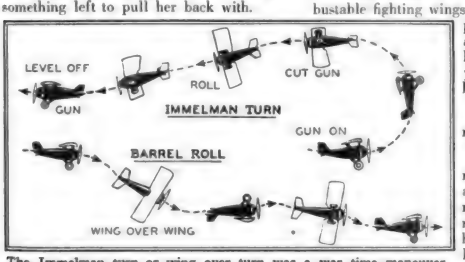
The main idea is to keep the wings level, and the ship looping in a true circle instead of as along a screw thread.

Not so hard.

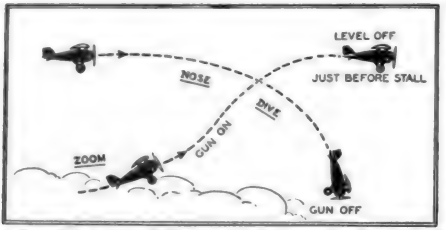
The outside loop is an angel maker if there ever was one. I have seen fellows try to do it, and I have tried it myself, but you can't try it with a ship which is very stable like a Waco or a Jenny or a Standard. For one thing, the normal wing loadings are reversed. You throw all the stress on the landing wires, which are only single. The only thing which will throw you around the loop is speed and plenty of it. Given speed and only one set of wires to carry a reversed load, and the wings of most ships would be near the cashing-in point. Stay away from the outside loop until you own a Curtiss Hawk or something with non-bustable fighting wings on her. Then, with plenty of nerve, and about 2,000 air hours' skill behind you, you might get by with it.

Now for the Immelman turn.

Old man Immelman was a German ace who preceded most of the now famous fliers. How he came to invent his Immelman turn, which is now being sadly corrupted by



The Immelman turn or wing over turn was a war time maneuver and is about the prettiest of all stunts. The ship is half looped, rolled at the top, and leveled off with a slight dive—gun wide out.



A "zoom" is a sharp climb—almost a dive upwards. Excess speed is gathered in a dive and the plane is zoomed to the stalling point. Motor should be cut in a dive.

calling it a wing-over turn, is hard to imagine. I doubt if he deliberately invented it. He probably got caught in a hot box during some engagement and found he had to go some place in one sweet heck of a hurry or get peppered.

It is the turning maneuver par excellence and was used to fool the enemy by a quick reversal of direction.

It is started by a slight dive, when the engine is throttled so it will not speed up much. Then it is gunned for all it is worth, and the ship slowly jerked into the first half of a loop. Doesn't matter which way the ship is rolled over, but if you roll it the opposite way the prop is turning, it will come over quicker. The trick is to get her right side up while you have flying speed, just before she stalls upside down. To do this you will have to start sticking her over when you are about one third up the loop so she will be rightside up with care when the burble point is reached—which it shouldn't be. That is, the burble point, or a stall, should never happen, or come to pass. The ship should sort of spiral up the half of the loop, coming out at the top half in normal flying position, going the other way from what it was when the turn started.

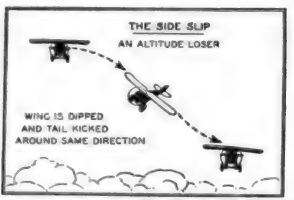
However, gang, you ain't seen nothin' till you've "bar'l rolled". That's a trick for the books!

The roll is started when you have gained plenty of flying speed in a gentle glide with the motor all out. The wing is flipped over and kept that way. Then the rest of the trick lies in keeping the ship in the line of flight. The tendency will be for the tail to whip and you will have to diddle the rudder and the elevator to keep the old mill banging along a direct path.

A variation of the roll is the falling leaf, so called because that's what it looks like to observers on the ground. The ship is sort of stalled, and as it falls the wings are whipped from side to side, first up and then up on the other side, with the line of flight normal. It is like the barrel roll except that the roll is never completed. The plane swings back and forth like a crazy pendulum.

Then there is the ordinary zoom, the stall, and the nose dive, side slip and tail spin yet to cover.

All but the last are simple as pie. The zoom is merely a sort of a hedge hop. You use up the excess speed and energy stored up from a dive to kite the old wagon skywards again. Only don't make the mistake of trying it too fast too near the ground. Early in the Pulitzer series of races an army Captain dove for the starting line, planning to jerk the ship out of the dive and scuttle along with screaming speed for the finish line.



As an altitude loser the side slip is a favorite because it is easily recovered from and will drop a ship quickly.

He got fooled. The wings bit all the air they could chew—they carried their maximum load and held, but the plane was a powerful, heavy one, and small. The wings

slid through the air, carrying full load, which was not enough to stop all the energy which had been stored by the dive.

The result was blotto for the captain. A few minutes later he was flatter than a pancake stepped on, and his friends were picking him up on blotting paper. If that had happened higher up the speed would have been finally damped out, the wings would have caught hold and instead of churning through solid air to the ground, helpless and hapless, the captain would probably be flying today, like all *careful* pilots are.

Nose dive? Nothin' to it! These ten thousand foot dives with power full on were myths of the war. The ship couldn't have been pulled out of such a dive for the flying wires would have pulled through the flimsy spars that war time ships were powered with. But there's no pilotin' needed in a nose dive except to pull her out of it gently, and to throttle the engine so it won't throw a con rod or the prop.

Side slip? Best little altitude killer known when coming in for a landing. Nose dives are faster, but they give you speed which you can't kill, and you are apt to over shoot the field.

The drawing shows how this is done.

Tail spins are a subject in themselves.

Tail spinning has often been called nose spinning, which is really more accurate, but as in the case of the Immelman, usage has leaned to the descriptive side rather than to the accurate technical side.

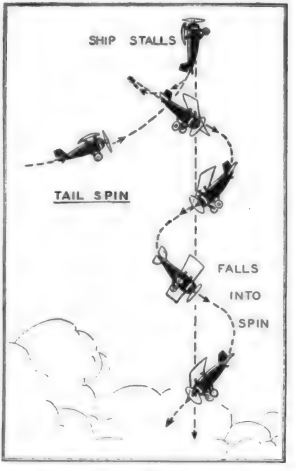
Tail spinning is safe enough if done at great height, and is decidedly the quickest way of losing altitude without gaining too much speed. It requires very great skill, but there is much confusion between nose spinning and "spiral dives".

The diagram explains tail spinning, primarily as a rotation on an axis, not in line with the body, but passing through the nose, merely because the side pressure at the front is the air force causing the spin. But this movement is quite distinct from a corkscrew twisting of the aeroplane on its own axis due merely to rolling the wings end over end.

Some ships will go into a spin just after a stall with the engine on and will come out by shutting off the engine.

A dangerous feature of spinning comes

What a Tailspin Really Is



The tail spin, often called the spinning nose dive. The ship falls flatly, rotating about its center of gravity. Set controls at neutral, or counter rudder.

in where there is too much side fin surface in front of the c. g. (center of gravity) as this stiffens the airplane, making it harder to get out. As a rule, ships with long tails will come out of a spin easily. Short ships spin readily.

As a matter of fact though, the airplane can be brought out of the spin or any of these positions by merely bringing all controls to neutral and just holding them there, courageously for a definite time. Then by pushing forward into a diving position and holding them there for a length of time to regain air control on the flaps the ship can be flown out of her predicament.

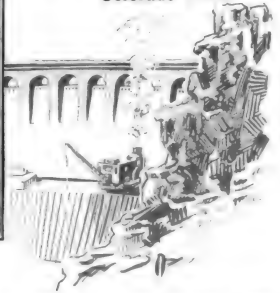
Now, you gang, I'll have to be signin' off, as the engine is warmed up, and the oil and water are warmed so we can gun the old bus and get aloft for a trial at it all.

The stick's yours!

Boulder Dam Will Be

Congress has passed the Boulder Dam bill, authorizing the construction of the mightiest dam in the world to harness the tempestuous Colorado River.

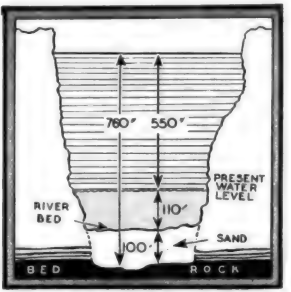
Above is a view of Black Canyon, the site of the Colorado River dam.



AFTER untold centuries in which it has been a bad boy among rivers, having its own gay way and disporting itself in such economically unprofitable occupations as cutting the grand canyon, the Colorado river is at last to be harnessed to the uses of man. Congress has recently passed what is commonly known as the Boulder Dam Bill, authorizing the construction of what will be the most remarkable dam in the world.

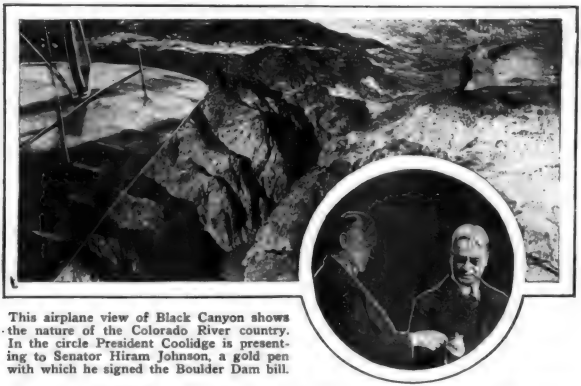
As an engineering project the construction of the dam has been described as "the greatest feat since the building of the Pyramids." The building of the Panama Canal is perhaps the closest approach in magnitude to the task which will confront the dam builders. Some idea of the tremendous proportions of the project may be gained from the fact that the sum of $70,600,000 was accepted by Congress as a reasonable cost for the dam. There will also be power plants installed to turn the turbulent currents of the Colorado into electricity, and these will add an additional $40,000,000 to the cost.

The political squabbles among the states through which the Colorado passes have held up development of the dam for a decade, and even now the state of Arizona is dissatisfied with the amount of water allotted her and threatens to carry her case to the courts. Nevertheless, the Boulder Dam



The mighty proportions of the Black Canyon dam are well shown in the above diagram.

Engineering Marvel



This airplane view of Black Canyon shows the nature of the Colorado River country. In the circle President Coolidge is presenting to Senator Hiram Johnson, a gold pen with which he signed the Boulder Dam bill.

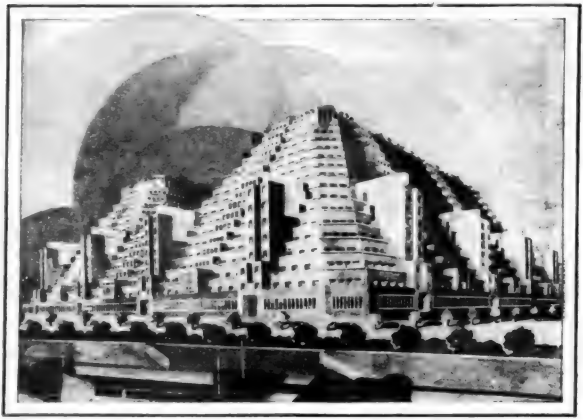
may now be considered as an engineering rather than a political problem.

Being a swift-running, turbulent stream subject to sudden floods which come tearing through its mile-high canyons, the problem of taming the Colorado is by no means an easy one. To begin with, coffer dams must be erected above and below the site of the dam, drying up a section of the river bed. The water must be carried around this dry spot by means of six tunnels, each 35 feet in diameter. These tunnels must be bored through the solid rock which forms the canyon walls—by no means an easy task. The coffer dams themselves will probably be formed by blasting away sections of the canyon, permitting the shattered rock to fall into the river bed, forming a natural dam.

This map pictures the Colorado in its role as the mightiest river of the southwestern United States.

In the exposed section of the river bed excavations must be carried through 100 feet of sand and gravel before bed rock is reached. A certain amount of water will very likely seep under the coffer dams so that pumps must be kept going all the time. Caissons may be necessary. When completed the dam will be 550 feet above the present low water level, or more than 660 feet above the present bed of the stream. This will make the Black Canyon dam by far the highest ever constructed. It will be twice as high as the famous Arrowroot Dam.

Paris Apartment Will Resemble Cubist Pyramid



TEN thousand persons will be the capacity of the extraordinary apartment house shown in the above photograph, which has been designed by the noted Parisian architect, M. Henri Sauvage. There will also be accommodations for 4,000 automobiles, grandstands in the several courts of the building capable of seating 3,000 persons in each, and a number of restaurants, swimming pools and tennis courts. The immense structure will occupy an entire block, and is designed to be a miniature self-contained city.

The step-back terraces give the building the appearance of an ancient Oriental pyramid. As pictured, the immense apartment building will rise alongside the banks of the Seine. Roof gardens, free to all tenants, will serve as parks for the apartment city. There will be 2,500 separate apartments in the building in addition to a number of provision shops and other establishments.

DIRIGIBLE DINING ROOMS BOAST HOTEL LUXURY

NEWER dirigibles such as the R-101, now being built in England, and the Graf Zeppelin, spare no expense in equipping their staterooms and dining halls with the luxury of first class hotels. The photo at the right shows the dining salon of the Graf Zeppelin, which, except for the unconventional arrangement of the windows, might be a scene from one of the country's finest hotels. Electric lights, soft, restful chairs, and the best of food and service are features which will appeal to passengers aboard these air liners.

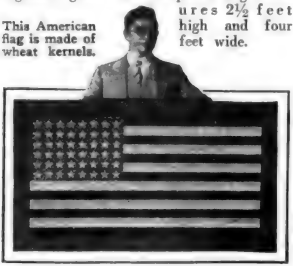
Dependable Electric Servant Runs on Batteries

NO LONGER need the housewife be at the mercy of a temperamental cook who is as likely as not to throw down her dishpans and quit just when important company has been invited for dinner—at least, she need not worry if she owns an electrical servant like the one shown in the photo at the right being examined by prospective purchasers. True, the mechanical man isn't yet able to make a salad or season the soup, but he can pass the pepper, shut off the gas, tend the furnace and make himself generally useful around the house. Despite his unhandsome appearance, the electric servant does exactly what he is told—in fact, he won't work at all unless the proper directions are spoken into a telephone in the exact words he is trained to obey.

Although at present the electric servant is purely an experiment, the inventors hope to perfect it so that it will become as common and indispensable an aid in performing household tasks as the vacuum sweeper or electric iron.

FLAG MADE OF WHEAT

THIRTY-THREE thousand kernels of selected Canadian hard wheat were required to complete the United States flag shown in the photo below. It is the work of Theophile Casaubon, 22, of Los Angeles, Calif., and represents 564 hours of spare time work. The flag is set in a background of natural colored wheat kernels, but the grains forming the red stripes and blue star background were colored by dipping them in oil paints three times to obtain the proper shade. They were mounted in place with vegetable glue. The completed flag measures 2½ feet high and four feet wide.



This American flag is made of wheat kernels.

PAINTING WITH ELECTRICITY

AN ELECTRIC spraying machine which can be used for painting, killing flies, and other uses, has recently been perfected. With this device it is a simple task to spray paint on the old family flivver or a shabby piece of furniture, and with the substitution of insect spray for paint in the reservoir of the machine it does good service in fighting flies. The device will spray any kind of liquid.

TINKERING PROMOTES INVENTION

TINKERING around the house, rather than necessity, is the true mother of invention, according to a study of American inventors recently completed by Dr. Lowell J. Carr of the University of Michigan. The investigation disclosed that 22% of American inventors began with some household device and another 6% with an article of wearing apparel. The majority of inventors are not interested in making money with their first invention, but are seeking to solve some problem that baffles them.

Million PLEASURE

The world's finest pleasure yachts are owned by American millionaires.

To the left is the magnificent new Diesel motored yacht of Irving T. Bush, of Bush Terminal fame.

The beautifully appointed radio operator's room on the Camargo. Millionaires' yachts these days are equipped from laundry to pipe organ!

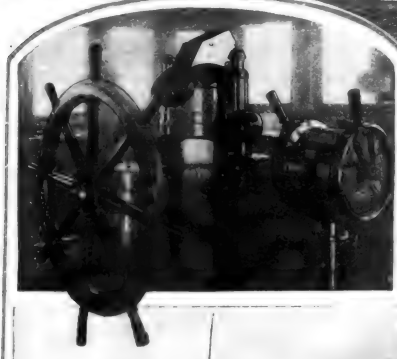
So retiring are millionaires these days that we cannot ascertain the name of the owner of the beautiful Diesel yacht Vanda pictured above. Instead of cumbersome country estates, men of affairs are building mobile floating homes these days.

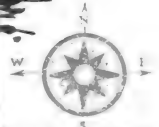
Dollar YACHTS

Lifetime dreams of America's captains of industry come true with the building of the world's finest yachts in which they can carry on their hobbies at sea.

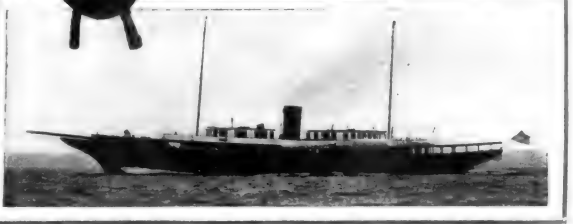
Down to the Sea with Started Sheets!

This lovely thing to the right is the yacht of Cornelius Crane, of Crane plumbing renown. Square rigged schooner, she harks to the days of Captain Kidd. Now on a trip around the world.



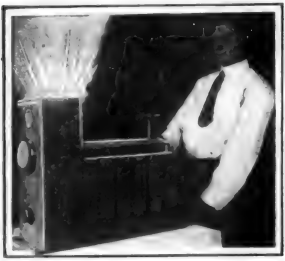


Rosewood steering wheel, polished brass binnacle and engine room signals, coupled with latest navigating devices give perfect safety to Camargo



Camargo is the name of Julius Fleischmann's huge new black hulled steel Diesel motored yacht. A total of 1,500 horsepower drives this floating palace, at better than fifteen knots.

Scientists Study Dust Explosions in Model Elevator



IN ORDER to study the destructive effects of dust explosions, and to demonstrate to owners of elevators and industrial plants the results which follow the igniting of dust by static electricity, the U. S. Bureau of Chemistry at Washington has built a sheet steel model of a grain elevator in which real explosions are staged. The photograph shows an operative of the Bureau staging a demonstration explosion. The roof of the elevator is covered with a piece of paper. An old auto tire pump is used to direct a jet of compressed air into a cup of dust, throwing it into the air in suspension. An electric spark is then introduced into the dust-laden air and it explodes with a concussion which sends flame and smoke spurting through the paper roof.

PEANUT SHELL SUGAR

XYLOSE, a valuable sugar which sells for $100 a pound, has been recovered from peanut shells and cottonseed bran by investigators at the University of Alabama.

YELLOWSTONE GEYSER IS HANDKERCHIEF LAUNDRY

VISITORS to Yellowstone Park frequently stop off to do their laundry at the famous Handkerchief Pool, a basin of hot water which derives its name from the fact that a handkerchief dropped into it disappears into its boiling depths to reappear a minute later thoroughly laundered.

ROBOT MAN PERFORMS

"ERIC ROBOT," the mechanical man who created a sensation in London a few months ago, recently made his American debut on the stage of a New York theater. He talked for the audience in a voice with a pronounced Oxford accent, cracked jokes, stood up, waved his arms, told time, winked his eyes, and in general comported himself in a very human fashion. Aluminum, copper, steel wires and dynamos substitute for stomach, heart and liver in the mechanical man.

A. Yellowstone Park ranger is shown washing his handkerchief in the Handkerchief Pool.

Building is Sawed in Half to Enlarge Dance Floor

CUTTING a building in half is not a task to be lightly undertaken, but the contractor in charge of alterations on the Minneapolis Auto Club clubhouse successfully performed this bit of architectural surgery recently when it became necessary to enlarge the building to accommodate the crowds which flock to this popular center of social activity. It was especially difficult to move the building because it is built on the edge of a bluff and any miscalculation might send it tumbling over the edge. The above photograph shows the two sections of the building, looking as if a giant bandsaw had just run through it. Timbers hold the cutapart sections together.

BIG RED APPLE HOUSES RESTAURANT

A RESTAURANT and dance hall in the shape of a big red apple does a thriving business on a highway just outside of Wathena, Kansas, catering to hundreds of hungry and thirsty autoists. Appropriately enough, a big cider press is located in the cellar of the restaurant and fresh cider is dispensed there. The apple-restaurant is painted a bright red. It is 32 feet in diameter.

RECORD AIR MAIL

FIFTEEN tons of air mail sent by the Willys-Overland Co., of Toledo, Ohio, were handled without difficulty recently by a fleet of 20 air mail planes. The shipment consisted of 700,000 individually addressed letters which were distributed to more than 6,000 towns throughout the United States in less than 48 hours.

Stamp-Size Model Train Housed in Cigarette Case

A MODEL train no taller than a postage stamp has been completed by an English model maker. The complete train, consisting of locomotive, two passenger cars, and three freight cars can be housed comfortably in an ordinary cigarette case, as shown in the photograph. Despite its microscopic dimensions, the train runs on its tiny track just as confidently as its larger brothers. Many hours of painstaking work are represented in the construction of the train.

AIRPORT FOR NEW YORK

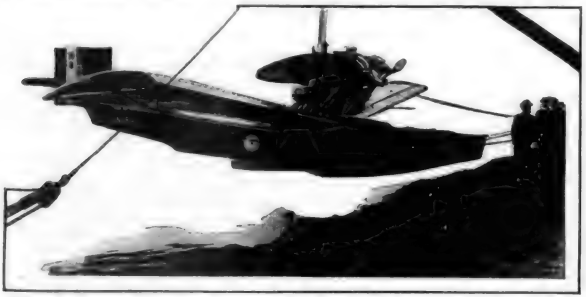
A $15,000,000 airport for the city of New York is projected by the investment banking house of E. H. Holmes & Co., which has assembled through purchase and lease a large tract of land within 20 minutes by automobile of midtown Manhattan. The airport will derive its revenue from landing planes and providing hangars for rental.

FLYING-BOAT LAUNCHED

ANOTHER claimant for the title of the largest flying boat was launched recently when the new British aeroboat *Inverness* took the water for its trial flight, as shown in the photo below. It is a sister ship of the *Inflexible*, the largest airplane in the world, which was built for the British air ministry. The *Inverness* is an all-metal flying boat with a wing span unusually large for craft of its type.

DUTCH RECLAIM SEA-BOTTOM

BY THE construction of a new dyke which is nearing completion a large section of the southern part of the Zuider Zee is being reclaimed for human use. Within two years 5,000 families will be living on the fertile clay sea bottom which is now entirely covered with water. The reclamation of this area was made necessary by the crowded condition of Holland, and will have the effect of adding a new province to this overpopulated country.



Above, the monster flying boat Inverness is shown being lowered into the water for its test flight.

Oil Fire Fighters Are Now Wearing Oxygen Masks

OIL COMPANIES have had a great deal of trouble in bringing in new wells recently. One of these drilling-in operations which resulted in a dangerous and destructive fire happened but a few weeks ago in an oil field at McCarney, Texas.

The men were called upon to snuff out the fire, and to this end they prepared an underground tunnel which led to the well pipe, where a room was dug and where preparations were made to cut off the pipe line and cap the flow from underground.

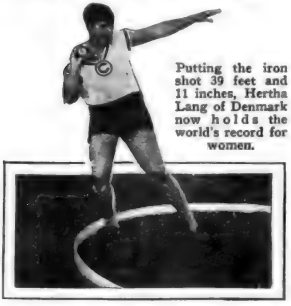
With a great deal of gas gushing forth from the pent-up store of petroleum, the fire fighters were obliged to design special equipment for coping with the total lack of air which was encountered in the operation.

To this end special masks were developed which were worn just as a diver wears a suit to enable him to breathe under water. The picture at the right shows the men emerging from their underground bake oven with asbestos suits on them, and their heads fitted with oxygen breathing apparatus.

Oil drillers at McCarney, Texas, were recently obliged to dig a tunnel under ground leading to the pipe which controlled the flow of a well which was burning. In order to work they were fitted with oxygen masks and asbestos suits.

CHAMPION SHOT PUTTER

SETTING a new record for the world mark in shot puts for women, Hertha Lang, of Denmark, has thrown the shot of iron 39 feet 11 inches. This young lady is strong and stocky in build and has won high honors in competition. Her record falls but little short of that set by men.

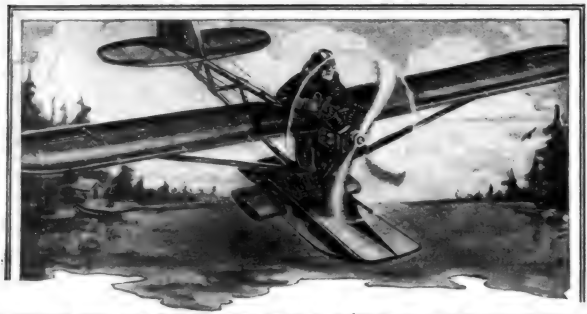


Putting the iron shot 39 feet and 11 inches, Hertha Lang of Denmark now holds the world's record for women.

COLLAPSIBLE OPERA GLASSES

A CLEVER Brooklyn inventor has patented a new opera glass which can be compactly carried in the pocket, and which will prove entirely effective in obtaining closeups of the player's faces.

The history of the correct usage of opera glasses throws an interesting side light on this invention. For many years, particularly in the "naughty nineties" it was considered quite the thing for polite folk who patronized the theater to use ornately furbished glasses. Latterly it has been considered queer for folk to use the aids to sight. The inventor of this device claims, however, that the objection to bulk and weight is overcome in his device to the end that people will soon be seen using them in theaters again.



A suggested design for a light flying boat for use in sheltered waters for "penguin" flying. It should be capable of short hops and would no doubt be great fun for the novice at airplane piloting.

The "WHY" of the Flying Boat

by WESTON FARMER

Here's the second article on water landing flying machines! This month the writer tells the characteristics desirable in floats for planes of the seaplane type, and gives dimensions.

HI, THERE, GANG! If you've been as dippy to get at reading this second article on the why of the flying boat as I have been to write it you are sure waiting for something. But let's cut out the foolery and get down to some real serious monkey business. I'm talkin' about seaplanes and flying boats, now.

The yen to fly from the water still persists among a lot of our readers, and the remarks I made last issue about the water being harder to fly from than land will have to be dinned in by experience. But far be it from us to let the itch for information grow into an ache. Let's look at the way seaplanes act. They are different from flying boats, which we touched on last issue.

Seaplanes are landplanes with pontoons under them where the wheels usually are. The pontoons are placed lower than the wheels because the water splashes into the prop if the ship is not some distance above water. There is no set rule, but in small ships a good rule to follow would be to let the water line be at least as far from the center of the prop hub as the propeller diameter. Some spray is bound to be flecked around by the prop, but the thing to avoid is the deluge which might ensue in rough water landings.

Flotation provided is usually 100 per cent to 200 per cent in excess of the amount actually required to buoy the plane up.

That is, in a small plane there should be enough buoyancy or displacement provided to float at least again as much as the loaded weight of the plane.

The shapes and the placing of the step in floats has some bearing on the performance of the ship, on its flying and takeoff and landing qualities. For instance, in a

light plane a width of about 12 to 14 inches for a single seat plane of the Parasol, Baby Bullet or Lincoln Sportplane type would conform to general practice. Usually, with the larger seaplanes a foot of width is provided for every 500 lb. weight, but as the beam of the floats decreases the water loses some of its ability to hydroplane that weight per foot of width at a reasonable speed.

The width of 14 inches per float is ample.

A shape is desired which will have the least resistance. The early fliers got along well enough with rectangular sectioned shoe floats. The stern of the front floats was placed about a foot aft of the center of gravity, so that the planing center or c.h.e. (see last issue) was the conventional 13 degrees ahead of the c.g. The tail was supported by a blob of a buoy or float attached to the butt end of the tailskid.

Such rigs might do for a light plane, but there is really no need for such crudeness.

A two float arrangement is stable enough, is as simple to build and can be much more effectively streamlined. For ships such as the three light planes mentioned, the Parasol, the Lincoln, and the Baby Bullet, floats ten feet long would be ample. They might be made of aluminum of about 16 gauge, gas welded at the seams, and of a curvilinear topside. That is, the top could be one sheet of metal, cut as though it were a part of a cylinder, and the two sides and the front end of the shoe riveted to the bottom. Bitulastic paint should be used to seal the seams. By now you will be asking questions, so I'm sayin' that while the eds. of the mag. will be glad to hear from you at all times on whatever you like in the book, or on what you don't, save the questions on floats for a month or two at least. We haven't got room to publish all the dope we have gathered on light float construction, so bide your time and full details will be published before long. That'll save me from answering your flood of mail.

Bein' that as it may, the floats should be spaced a trifle wider than the wheels. The usual angle of the landing gear Vee, carried down so that the floats will come as far from the water line as the propeller diameter is, will be a safe enough procedure to allow for.

But about the placing of the floats: The fore part of the float, instead of being sharp and turning up abruptly, ought to be rather full and flat, as the little side drawing above the Baby Bullet picture shows.

The step should be about three inches deep, and come about .6 of the hull length from the bow of the float. The heel of the step should be placed directly under the center of gravity when the plane is loaded, or a wee bit aft of it. This will insure the float being placed so that the c.h.e. is far enough forward to prevent pitching over snootwards.

See you next month!

As announced in previous issues of Modern Mechanics, plans for the Baby Bullet, shown above, will appear shortly in Modern Mechanics. Such a plane, equipped with aluminum floats, would look like a miniature Supermarine—Napier, the plane in which D'Arcy Greig flies at 318 miles an hour. The Babe is capable of a speed of 150 m. p. h. with her wheeled under carriage, and could probably clock along at 140 with floats. Plans for a seaplane adaptation of the Babe are under way, and also plans for the Flying Bathtub, announced in last issue.

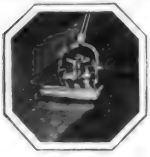
Tiniest Plane Nestles Under Wing of Bomber

The Heath Baby Bullet, claimed to be the smallest man-carrying airplane in the world, is shown standing in front of an Army transport plane at Mines Field, Los Angeles.

WHEN the Heath Baby Bullet crawled up under the landing gear of an Army transport plane and nestled beneath the wing, it was another case of David and Goliath or Mutt and Jeff getting together. The Baby Bullet carries but one passenger and is powered with a 2-cylinder motor, whereas the Army plane accommodates half a dozen men and a few thousand pounds of baggage and equipment for good measure. Note the tiny wings of the baby plane; they are little more than fins projecting from the fuselage. The total wing spread is only 18 feet. Relative sizes of the two planes can be compared by the heights of the two men. Complete plans for building the Baby Bullet plane will appear in an early issue of Modern Mechanics.

CLEANER POLISHES FLOORS

ELECTRICITY now polishes hardwood floors as well as cleans the rugs in a new combination vacuum cleaner recently put on the market. The photograph shows the cleaner being used to wax the floor. A slight alteration of the machine converts it into a regular vacuum cleaner. According to the makers, the one machine is all that is necessary to keep house floors and rugs in perfect condition. It operates from the house current just like an ordinary vacuum cleaner.



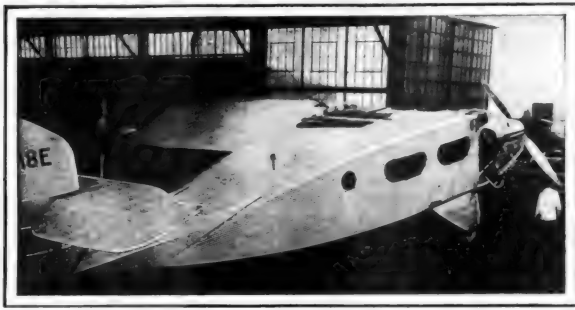
CHEWING GUM RESEARCH

RESEARCH into the chemical composition of chewing gum discloses the unsuspected fact that 5% of each stick is pure rubber. The rubber, of course, is not precisely the same as that in rubber heels or automobile tires, but is pure, fresh rap, secured in large quantities from the *sapote* tree of Central America. Chicle is the commercial term for the basic elements which give chewing gum its "snappiness." After chewing a stick of gum it has only three-fourths of its original weight, the missing 25% representing sugar, dextrine and other ingredients which go to make up the tastiness of the gum.

SERVICE BOOTHS IN STREET

A NEW type of kiosk which is a combination postoffice and telephone booth will shortly make its appearance in the streets of London, having been approved by the government authorities. A photo of the new kiosk appears below. Automatic stamp vending machines are installed which deliver stamps at the drop of a coin, and a mailbox is also provided for mailing. A pay telephone completes the equipment. Electric lights are fitted into the kiosk, which is to be a permanent feature of many of England's busiest streets.

New Wide Fuselage is Approach to Wingless Plane



AN AIRPLANE of a new type possessing a fuselage more than twice as wide as is customary has recently been put into service by an eastern transport company. The above photograph shows a clear view of the unusual fuselage before the right wing was attached. Note that the upper part of the fuselage is practically level with the lifting surface of the wing. Aviation leaders hail the new plane as a step in advance towards the construction of a wingless airplane, for the wide fuselage exerts a lifting effect of four pounds per square foot which adds materially to the flying qualities of the craft. B. J. Burnelli is the designer of the plane.

AUTOGIRO TESTED

FAMILIARLY known as the "windmill" plane because of the four-bladed rotors affixed to the fuselage of the ship which give it the ability to lift itself almost vertically, the Cierva Autogiro is at present undergoing tests which if successful will result in the building of a 12 passenger plane which will fly at 130 miles an hour, yet will take off and land in a space 100 yards square. Present autogiros can make almost vertical descents and once they take off can rise almost straight up, but an abnormally long run has been necessary to develop sufficient speed for the takeoff. The builders have now perfected a mechanism which imparts the necessary initial speed to the rotors, enabling them to "rise from a postage stamp."

Officials of the Minnesota State Agricultural College have planted 14 rocks at various depths in the ground to determine whether or not they work up to the surface. Data obtained will be used in determining the value of clearing land of rocks.

GOAT MILKING STILE

ANYONE who has had experience in milking goats will realize that the process is considerably different from milking cows, owing to the small stature of the animals. To obviate this difficulty, a California man devised a stile which permits him to sit down and milk his herd of goats in comfort.

This elevated milking pen was invented by a California man to make it easy to milk his herd of goats.

Edited by MAJOR H. H. ARNOLD

Major Arnold, editor of this department of Modern Mechanics, is a pioneer in aviation and a veteran army flier. He served as assistant chief of the American Air Service during the world war. Later he became chief of the Ninth Corps Area. His expert comment on aviation developments is a regular monthly feature of the magazine.

Tanks Must Combine Light Weight and Strength

THE construction of gasoline tanks for airplanes was not much of a problem to the early designers. The engines were so unreliable that a small amount of gasoline would be sufficient to maintain the airplane in the air as long as the engine would continue to function.

With the increased reliability of the power plant, the necessity for carrying larger amounts of gasoline became quite a serious problem. Tanks made of terne plate were quite heavy on account of the many baffle plates required to keep the gasoline from slushing around. The tanks had to be made sufficiently strong to carry the load without springing a leak. The stresses and strains imposed by 100 gallons of gasoline slushing around unrestrained can be visualized when it is realized that 100 gallons of gasoline weighs more than six hundred pounds.

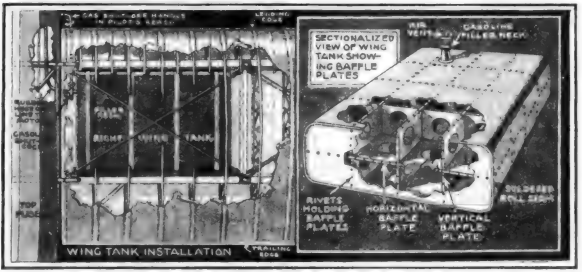
Every effort was made to secure a lighter material for tanks to replace terne plate, but the designers always ran into the same difficulties—how can duralumin or aluminum be welded? Both of these metals could be turned out in sheets suitable for tank construction, but the binding together of the seams was apparently an unsolvable problem.

Then followed a period when the military authorities demanded crash and fire proof tanks. These were necessary to keep the planes from catching fire when the tanks were hit by incendiary bullets and to prevent the gasoline tanks from exploding and throwing the gas over the hot engines after a crash.

Experiments proved the feasibility of providing such tanks, but they were very heavy. It was a simple matter to cover the metal with alternate layers of felt and rubber. Thus the felt and rubber tended to seal up bullet holes and retained the gasoline within when the tank was battered and crushed in a bad wreck. The weight, however, kept steadily mounting. The fifty or sixty additional pounds utilized in a terne plate tank over the weight of a duralumin tank of the same capacity would allow another ten gallons of gasoline to be carried. It was the weight of a radio set, camera or machine gun with ammunition.

It was about that time that the art of welding duralumin became perfected. Thus today the majority of airplane gasoline and oil tanks are made of duralumin. The joints are welded together and the rivet heads which secure the baffle plates to the

Gas Tanks in Wing is General Practice in Modern Airplane Design



Showing details of gas tank installation in airplane wings.

sides of the tank are welded to make them leak proof.

At first it was feared that the constant vibration of the airplane would cause many leaks in these tanks and the first few tanks did have a tendency to spring a leak. However, as the mechanics became more expert, the duralumin tanks became just as serviceable as the terne plate or brass ones.

In the older types of airplanes the practice was to install one large gasoline tank. Thus there are many planes still in service which have tanks with gasoline capacity of 100 gallons or more. The T-2 in which Kelly and Macready made their trans-continental flight had a tank which held almost eight hundred gallons. Today the practice is to install a greater number of tanks with smaller capacities.

The common practice is to have a gravity tank with a ten or fifteen gallon capacity for starting and emergency use. Thus fuel will be available for a landing even though the pumping system should go bad. Then there are two or more additional tanks available which can be turned on as needed. These tanks may be installed in the fuselage or in the wings. Their location is decided upon by the designer of the plane in accordance with his plan for distribution of weight.

Certain of the army planes have gasoline tanks as follows:

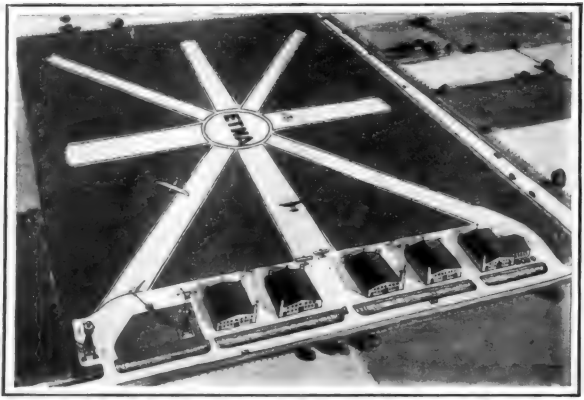
Gravity tank	**18 gals.**
Main tank in fuselage	**38 gals.**
Wing tanks, two	**118 gals.**
Total carried	**174 gals.**

For ordinary flying this permits the plane to stay in the air for about eight hours or travel about 800 miles.

Practically all of the wing tanks and most of the fuselage tanks are now installed so that they can be dropped at the will of the pilot. This is a most desirable feature in case of a forced landing. By dropping 100 or more gallons of gasoline the weight carried is materially reduced and a much slower landing can be made.

The tanks are supported in slings. These slings are unfastened with a catch operated by a handle in the pilot's cockpit. The connections on the pipes leading from the tanks to the carburetor are sheared off when the tank drops. These connections are usually made of rubber with a metal fitting inside.

This huge airplane beacon, 125 feet high, is one of a series of 30 being erected on the Pacific coast by an oil company. The lettering is formed of brilliant neon lights, with a three-sided beacon on the top which will be visible for 50 miles on clear nights.



An ideal modern airport as drawn by Stewart Rouse. Note the essential features such as boundary lights, illuminated port name, beacons and wind direction indicator.

Up-to-Date Airport Necessary for Modern City

AVIATION companies have felt the demand of the public for better accommodations at their landing fields. The day of the gypsy pilot is passed. In the early days of aviation it was all right for the airplane to be parked in a cow pasture somewhere and the venturesome air passengers to stand in the dust, mud or rain while waiting for their ride. Now things are different. Air transportation companies have established themselves as common carriers and as such must come up to the standard set by bus lines and the railroads.

Two or three years ago, while it only required about two hours to fly from Washington to New York, the actual time necessary to get from the hotel district in Washington to down town New York was longer than that required when traveling by train. The reason for this was the great distance of the airports from the two towns and the poor connections made at the two ends.

A million dollars is a large sum of money and should go a long way toward the construction of a modern up-to-date airdrome. However, when it is considered that some cities have already spent that much and are spending more to complete their airports, the magnitude of such a project can be realized.

The first step necessary is the selection of a site. The field must be large enough to permit the landing and taking off of any type of aircraft during the day or night. Furthermore it must be close enough to the heart of the city so that there is a minimum of time consumed in getting from the airport to the business district. Such a piece of land will always come high.

After the selection of the ground, it is necessary to level it off so that the planes will not crash when using it. There are few if any stretches of ground having even comparatively level strips that extend for a distance of two thousand feet, and yet that distance is the minimum required for modern airplanes. Concurrent with the grading of the landing field comes the construction of a good all-weather road leading to the line of hangars. Even with the completion of these projects the airport is not more than started.

The model of all airports is being established at Pau, France. Other cities en-

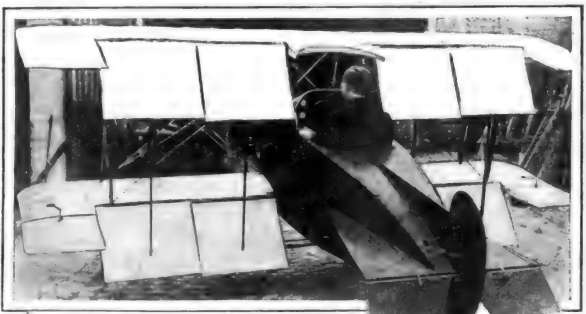
deavor to provide as many of the necessities and conveniences as their funds will permit. At Pau the field is square in shape and permits airplanes to land directly into the wind regardless of its direction. The lighting system consists of boundary lights extending along its limits, searchlights throwing their beams into the air to attract the attention of aviators, landing lights for guiding the planes to the ground and spotting lights to illuminate the planes when they are safely on the ground.

At one corner is a light which rotates its beam in accordance with a navigation code and thus identifies the airdrome. In the centre is an illuminated marker which serves to orient the pilot as to where he should set down the wheels of his plane in landing. The buildings are all outlined with lights, thus making it comparatively easy for the pilot to pick out his taxiing direction.

The installations for maintenance and storage of airplanes are most complete. There are hangars for the use of planes during their stay at the airdrome. Machine shops are available for the repair and construction of parts for repairs of planes and engines. Enormous storehouses contain spare parts for the various types of planes and engines which will use the field. Thus every effort is made to predict the calls which will be made for airplane service.

In a similar manner the needs and conveniences for the traveling public have been anticipated. Rooms with modern accommodations are available for the transients who visit the place. Restaurants are placed at convenient points. There is a custom office for the clearance of passengers arriving from foreign countries. As tickets are needed before travelers can get aboard the planes, ticket offices are provided at which passengers can secure tickets over any of the air lines utilizing the field. There is even a money exchange where the currency needed at the next stop can be secured or foreign money exchanged for French.

The planes on landing taxi into a large shed. This shed has clearance sufficient for the largest of airplanes. The planes taxi into a well-lighted, dry, fairly warm room where the passengers can debark in ease and comfort. Three planes can be accommodated at the same time. Thus the passengers need not suffer the inconveniences of dust and mud so prevalent at aviation fields. Immediately after unloading, the planes are taken to other hangars for storage.



This home-made airplane is claimed by its Belgian designer to be the smallest practical powered plane in existence. Note the unusual arrangement of the wings. The tab-like projections are expected to act as brakes in stopping the plane, and also to give lifting qualities to the wing.

Making MAPS from SAWDUST

Ewing Galloway

A workman is shown carving a plaster cast from which a map matrix is made.

RELIEF maps which in the past have been turned out by hand at great expense are now manufactured in quantities at small unit cost through a new process developed by a large map manufacturer of Munich, Germany. Sawdust, glue and paper are the elements from which the maps are built up.

Above an artist is coloring the finished map.

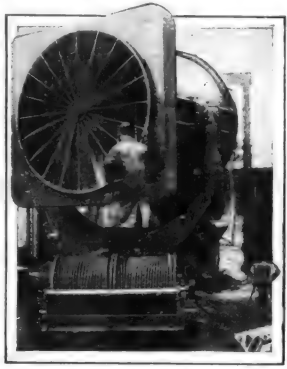
The first step in the process is to carve a master cast in soft plaster as shown in the picture. This is a delicate operation, requiring the services of a skilled workman, who works from an ordinary flat map with elevations marked with the conventional contour lines. Two hundred hours is sometimes required to complete the intricate plaster mold.

A mixture of fine sawdust, pressed between sheets of paper on which glue has been spread, is squeezed down upon the master model by a huge press, forming a matrix. Once this matrix is completed, duplicate maps can be cast from it at the rate of fifteen an hour. The rough casts, of course, show only the elevations and it is necessary to paint in the rivers, lakes, and other physical features by hand. Women artists are employed for this purpose. When completed the map looks very much like an airplane view.

Cheapening the manufacturing cost of relief maps puts them within the reach of small schools and institutions which have been unable to afford a set of expensive, hand made maps.

London Airport Has World's Largest Searchlight

STANDING fourteen feet high and boasting a candlepower of three and a half billion, the largest searchlight in the world was recently completed and put into service at Croydon field, England's big airport outside of London. The man standing on the cable in the picture gives a good idea of the size of the giant beacon. The projector alone, which is that section of the lamp through which the beam shines, is seven feet high. The beam will be visible for a number of miles out in the English Channel, serving to guide aviators making the journey across the continent. In spite of its huge size, the searchlight can be easily operated by one man.



$25,000 SHIP BLOWN UP

AS AN example of the lengths to which the movies go in obtaining realistic shots for feature films, the recent destruction of a $25,000 ship by dynamite stands as a record. Three hundred cases of dynamite were used in shattering the ship, and the explosion was heard 25 miles away. The picture was filmed in the Pacific off the shores of Catalina Island, California. The entire scene occupied but 20 feet of film in the completed picture, which made the expense of this particular shot better than a thousand dollars a foot. A 250-foot schooner was the ship used for the scene.

The above picture shows the $25,000 explosion in which a 250 foot schooner was blown up for the movies.

RADIO IS TUBERCULOSIS CURE

ULTRA-SHORT radio waves have been used by a German scientist to good effect in treating tuberculosis. In a recent test 30 mice were inoculated with tuberculosis germs and 15 of them were exposed to the short wave treatment. The animals so treated were alive and well at the end of a month, while the others soon sickened and died. One objection to the use of these short waves is that they are dangerous to handle, causing an increase in body temperature as well as the disintegration of cells containing albumen. Mice exposed to strong short waves died almost instantly in convulsions.

60 SERVANTS PER PERSON

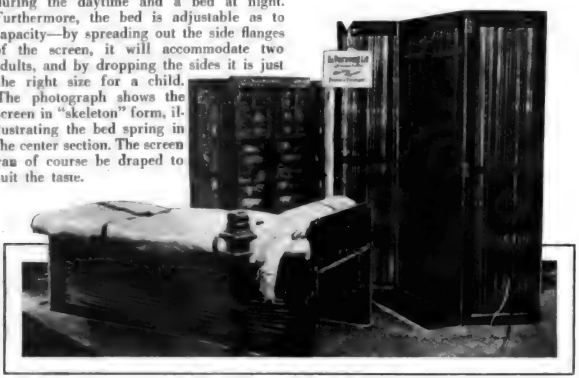
EVERY man and woman in the United States has the equivalent of 60 servants constantly in attendance. These servants are machines which perform an amount of labor equal to 60 times that which could be accomplished by the entire population of the United States, working unassisted. The horsepower at the disposal of the factory worker has nearly doubled in the last quarter century, yet there are still a vast number of spots in the United States where man enjoys no more mechanical assistance than a man of the stone age.

Cottage Tree-Dwelling Has Modern Conveniences

ELECTRIC lights, modern plumbing, and all the conveniences enjoyed by the ordinary home are provided in the California tree dwelling shown in the photo. It was erected by a health seeker in the hills north of San Diego, California, at an elevation of 5,000 feet. The cottage is mounted between two trees and the floor timbers are anchored to the tree trunks. Access to the cottage is gained by a rustic stairway which the builder has erected. Although the building is only 8 feet square, a bed, table, and kitchen equipment are crowded into it. The owner, being a California booster, doesn't mind the crowded condition of his home, claiming that he spends most of his time outdoors anyway!

SCREEN BY DAY, BED AT NIGHT

GOING the folding bed and collapsible bath tub idea one better, a Parisian cabinet maker has invented an article of furniture which he claims is the last word in adaptability. It can be used as a screen during the daytime and a bed at night. Furthermore, the bed is adjustable as to capacity—by spreading out the side flanges of the screen, it will accommodate two adults, and by dropping the sides it is just the right size for a child. The photograph shows the screen in "skeleton" form, illustrating the bed spring in the center section. The screen can of course be draped to suit the taste.



Above is shown a Parisian cabinet maker's combination screen and bed.

PLANES FLY 58,000,000 MILES

COMMERCIAL and military planes of the United States traveled 58,000,000 miles during 1928, according to a recent report of the American Air Transport Association. This mileage included air mail, express, passenger and civil flying. Mail planes alone flew 7,200,000 miles, carrying 1,700 tons of mail, 30,000 express packages, and hundreds of passengers.

Twelve-Inch Tire Built for Heavy Service

ONE of the largest pneumatic tires ever built for regular automobile use was constructed by a German maker for use on heavy trucks. It was exhibited at the International Motor Show at Berlin. The giant tire measures 12 inches in diameter, fully twice as wide as the largest tire commonly used on pleasure cars. By using these large tires in pairs on the rear wheels, motor buses of larger capacity than any now in service can be built.

BUILDS RADIO TRANSMITTER FOR $7.00

A PORTABLE radio broadcasting transmitter, shown in the photo below, has been built by Charles Musser at a total cost of $7.00. It is operated by B batteries and has an effective range of 150 miles. The set is of the short wave variety and is exceedingly simple in design. As will be seen in the picture, the set can easily be stored in an ordinary suit case and carried about in the back seat of an automobile. Instead of a microphone, the builder has adapted an old telephone transmitter to his use.

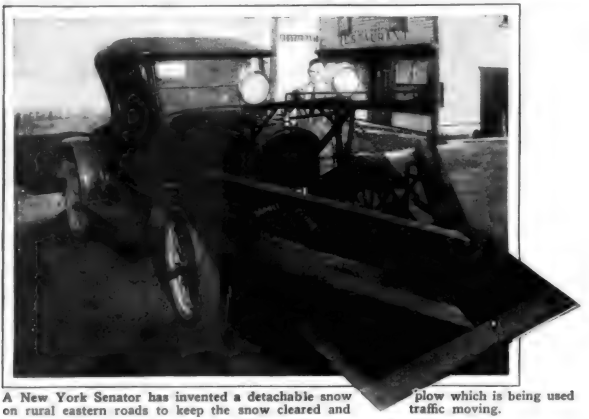
The inventor, who is a reporter for a Washington newspaper, plans to use his home-made broadcaster in covering news stories which call for quick and full reports to the newspaper office. The set can be removed from its carrying case and set up for operation in a very brief time.

RADIUM BOUGHT AT $50,000 PER GRAM

SIX million crowns, or approximately $1,500,000 in American currency, has been collected in honor of the Jubilee of King Gustav of Sweden. Of this sum $300,000 was set aside for the purchase of radium to be distributed among Swedish hospitals where it will be used in treating cancer and similar ailments. Fifty dollars a milligram, or $50,000 per gram was the price paid for the rare element, purchased through a Belgian dealer. This price is said to be the lowest ever paid for radium.

Charles Musser, builder of a radio broadcasting transmitter, is shown above with his set, which cost only $7 complete.

ENTER *this* NEW USES



A New York Senator has invented a detachable snow plow which is being used on rural eastern roads to keep the snow cleared and traffic moving.

THAT popular old Model T Ford may be extinct so far as additional production is concerned but its glory will continue indefinitely in new form and on entirely different stamping grounds from those on which it was originally made to run.

Science says there are hundreds of uses for an ordinary needle. Efficient practice demonstrates that there are as many if not more unusual uses for venerable "tin lizzies" from Detroit after they have served worthily and well as passenger vehicles.

Out in the rural districts where gasoline power is replacing hand labor activities wherever possible, discarded Model T's are serving more unique purposes than the multiplication table or the law of averages. In many measurable ways, an old Ford is proving an economical form of farm relief.

In the potato raising districts from Maine to Florida and as far west as Idaho, growers are using their discarded motor cars to operate potato cutting and "eyeing" machines. It is a tedious task preparing potatoes for planting by hand. Growers have eliminated this objectionable job from the schedule by blocking one rear wheel of the car, removing the tire from the other wheel, attaching a pulley in its place and harnessing this spinning wheel as a source of belt power to operate home-made potato cutting machinery. One Ford yoked in this novel manner will do as much work per hour as

Florida farmers drain their muckland by using a 2½-inch centrifugal pump hooked to the propeller shaft of an old model T Tin Lizz.

for Old Fords Contest!

Have you seen a Model T Ford in a new role? Send us a photo or description. If we can publish it we'll send you $10.

A Los Angeles landscape gardener has mounted an emery wheel on his Ford to keep his tools clean and sharp

20 men "eyeing" potatoes for planting by hand.

Heavy hauling over the muckland fields of Indiana, Illinois, Michigan, Florida and other states is difficult with ordinary vehicles because the wheels soon become mired in the soft soil. Horses used in the cultivation of such fields have to wear large wooden shoes something like snow-shoes to prevent them from becoming bogged.

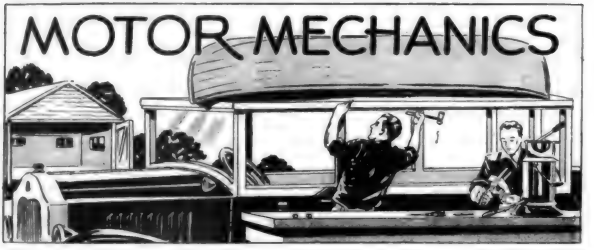
Up in New England where improved highways abound and the annual snowfall is heavy, old Ford cars are being used in the winter-time battles against Boreas and resultant road-blocking blizzards. A New York state inventor has originated a light-weight practical snow plow which is mounted in front of the automobile. These mechanized shovelers are popular for keeping highways, byways and farm roads free of drifts and open to daily travel.

Florida growers who specialize in the production of winter vegetables use home-spun irrigation systems with old Ford engines as the source of pumping power. There are a half dozen such outfits in the vicinity of Fort Lauderdale in Broward County, Florida.

Some farmers or mechanics use abandoned Fords equipped with the prerequisite pulleys or castings to function a line shaft installed as a permanent fixture in barn or shop. This power can then be used for a variety of operations such as elevating corn and wheat from wagon to overhead bins, operating a small portable saw for cutting stove wood or rough lumber, pumping water, grinding feed, macerating hay and fodder or for running a lathe, scroll saw or other shop tools.

Nebraska and Kansas grain farmers use old Fords efficiently as power sources to run their grain elevators. In some cases the chassis of the car is removed and only the engine and radiator are used. In other instances the running gear with only the body removed is employed.

Up in Michigan this wind wagon was made from old Ford parts. The prop used is an old 0X5 toothpick.



A GYPSY Car for Touring

How to Build a Camp on Wheels

By RAY F. KUNS

THE first point to be given thought when considering building a car for touring and camping, is the size of the car or outfit desired. Generally it is desired to sleep in the car. This may be done in two ways, either with the occupants lengthwise or crosswise of the car.

Experience has shown that a car wide enough to permit a six-footer to sleep across it may be just a little too wide for convenience in handling on the road. The recommendation is to lay out the berth or berths lengthwise of the car.

The general consideration given above indicates that a body of 10 to 12 feet in length is needed. If you will measure any of the average touring cars, you will find that this is considerably in excess of the touring car body length. It is a well known fact that too much weight may not be carried on the rear axle, especially if there is a great deal of overhang. It is doubtful whether any attempt should be made to build a special body on a passenger car chassis of less than 125" wheel base. A wheel base of from 140 to 150" is better.

Under these circumstances, it is usually a good plan to take a medium priced car which is known to be in good condition mechanically, although perhaps a trifle obsolete in body style, and cut and extend the frame. In this way a wheel base may be secured which is even more satisfactory than that to be found in some of the heavier passenger cars.

The type of body suggested is such that little, if any, extra weight will be the result. The main idea in the construction of the special touring car body is to get as much room inside as is possible while keeping down the weight of the job to the point where speed and power need not be sacrificed. The idea of building up any sort of a body on an under-powered chassis is not relished nor is it in keeping with touring standards. In these days of high touring speeds, a driver is in an embarrassing situation when he goes on the road with a car that is overloaded and under-powered. A little thought given to body design, es-

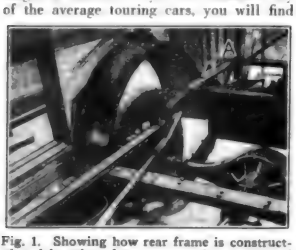


Fig. 1. Showing how rear frame is constructed and lengthened to accommodate weight of touring body.

A completed touring car built after the plans given in Mr. Kuns' article is shown above in camp on the shore of a lake in Ontario. Note the boat on top of the sturdy roof and the convenient seat which can be removed from the car when desired.

pecially to stream lining and weight, will give the owner a very great deal of pleasure both on the road and in camp.

With the beautiful car bodies which one sees on every hand a home-built touring car cannot have a lot of rough corners and the owner get his full satisfaction in use, but the mere thought of working out sheet metal panels for a body covering is enough to discourage the average amateur builder. Across "the pond" many bodies are built out of what is termed fabric construction. It is an ideal method for the use of the individual builder. The plan is to set up the frame work of the car and work out in a rough way the curves and stream lining of the body so far as the frame is concerned. The next point is to select some square mesh wire of about 16 or 18 gauge, with ½-inch mesh. It may be tacked over the frame and even worked over the curves nicely. Slight irregularities are of no particular consequence as long as the general contour is secured.

After the wire is on, the next step is to lay on it one or two layers of cheap cotton batting. Over this cotton batting will go the special body covering, which may be secured in any shade or color desired. This is the material which the average amateur calls "imitation leather." It appears on the market under a number of trade names. It can be purchased from the automobile top man or from the supply houses. Some very beautiful effects may be secured by giving thought to color harmonies.

The reader, having gained a general idea of how to proceed with a job of this kind from the illustrations and descriptions published herewith, should give thought to the

Fig. 2. This view shows the body framing almost completed.

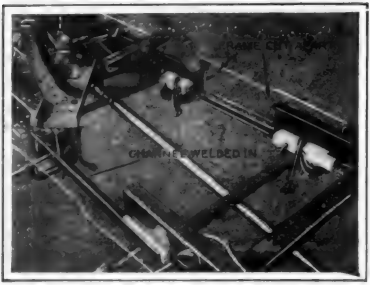


Fig. 3. Here the passenger car frame is cut apart for lengthening. B and C are pieces cut from an old frame ready for welding into place.

selection of a chassis which is sturdy and has considerable life left in it. It should have a good strong frame, four-wheel brakes, balloon tires of ample cross-section and chassis units known for their reliability. Do not select a worn-out chassis from the junk-heap—the better the chassis, the better your touring car.

Stretching Out Frame

Having selected the car the chassis should be stripped. This means removing the body, fenders, running board, etc., to get right down to the frame. Having decided on the length of wheel base desired, preferably 140 to 148 inches, the frame may be sawed in two at a central point. The next thing to do is to pull the two ends of the frame apart and measure the distance between the ends so as to secure the proper length of wheel base.

For instance, if the original wheel base were 124 inches, you will pull the frame ends apart until there is 24 inches left between the newly cut ends. Run two wires along the edges of the frame and clamp on pieces of angle iron to support the two sections of the frame in line, measuring from the aligning wires on the side. This process is well illustrated in Figure 3. The section of the frame to be welded into the opening thus provided should be cut from a frame of the same general construction. The junk man or the car-wrecking establishment usually has a number of these frames on hand, and will permit you to cut out several sections such as you will need for the price of the junk. Two such sections appear at B and C in Figure 3. It will be noted that these have been cut out with a cross member riveted to them. They should be set up as shown in Figure 4. Have them clamped in position for the welding job. It may be that the ends of the cross member will not meet at the center. If they do not, simply cut a section of channel and weld it in position.

You are now ready to invite the local oxy-acetylene welder around to your place some evening and have him weld the frame for you. A professional welder will do this job at a rate which is not excessive and will assure you a good job. The fact that you have provided him with sections of metal identical with that of the frame makes his job easy.

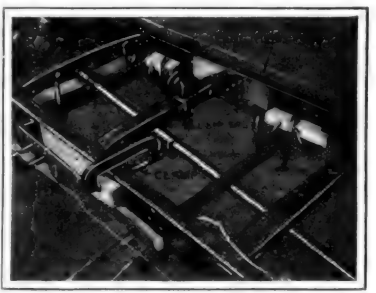
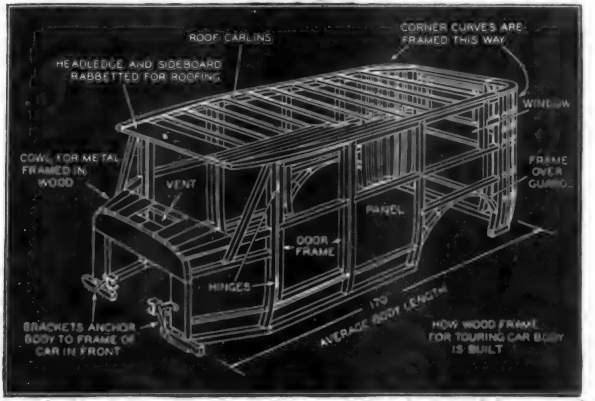


Fig. 4. All ready for welding. Note how the short pieces are clamped in place until the welding operation is completed and they are a permanent part of the frame.

The Framework of Touring Car Body is Shown in This Blueprint



The above blueprint shows the skeleton of the home built touring body. It is recommended that the design be followed closely as it combines great strength with light weight.

The Propeller Shaft

There is another chore which the welder will have to do for you; that is to provide you with a new propeller shaft. If you will remove the old propeller shaft and allow him to take it to his shop, he will remove the hollow tube from the universal joint flange and splined shaft and weld on to them a new tube which is just as much greater in length as was the section set into the frame.

It is easier to stretch out a chassis with an exposed propeller shaft than a car having an enclosed propeller shaft.

The brake mechanism has been disturbed more or less by cutting the car frame and installing the new section. As a rule all that is necessary is to provide one or two new brake rods or to have the welder stretch out the old ones a proper amount. At the rear of the car a steel section should be bolted on. This may be a piece of angle iron, as suggested in Figure 1 at A. This angle iron is ¼"x2"x2" and runs back as far as the builder wishes, then across the car frame. The posts are hung to it at the rear by means of lag screws through the angle iron.

Starting The Body

The first thing to do is to start with those parts which are already determined. Set the car level and block the frame in that position. Start with the hood line and the running board brackets. Select some good solid stock, such as oak, for the running boards and bolt them in position under or on the brackets, as desired. Next bolt on the front fenders and attach them to the running boards. You may now set up boards and clamp them in position for the forward end of the hood, as indicated at A in Figure 7. Just clamp these boards up in a temporary fashion, then support the hood in the position which it will assume, marking around it for the curves; after which the boards are removed, cut to the line, bolted or framed together and then bolted in permanent fashion to the side members of the car frame. Make certain to allow these boards to extend down as far as the running board, whether they hit the running board or not.

The stream line of the body is secured very largely through the position of the posts and the curvature of the outside of the post. If you will refer to the blueprint

Fig. 5. The meshwork of wire to which the fabric covering is mounted is here shown attached to the frame.

you will note that the outside top of the post is straight and perpendicular, the inside is straight but slopes inward and the lower outside of the post has a curve. This curve may be modified as you desire. The roof plan will give you an idea of the curvature of the sides. The posts should be made about 1¼" thick and about 3½" wide at the center. Lay out a pattern for the posts (most of which are very similar) and saw several of them to this form. Set these up at the position which will correspond to B in Figure 7, one on either side, and brace them in this position. You may now proceed with framing up the windshield and the hood structure.

The amateur should make no mistake in selecting his wood. Strange as it may seem, there may be a variation of 1,000 pounds weight in a body of this size, owing to the selection of materials only. For instance, oak weighs approximately twice as much as spruce. Spruce is ideal for the job owing to the fact that it is strong and tough. Oak is ideal, of course, except for its weight. Ash is a very good wood for body work. Figure the weight of all materials added to the body and remember at all times that it is worth while to save every pound possible.

Having the hood and windshield lines framed up and well braced, the next point of attack is the rear posts—those forming the support for the rear window and the trunk. These may be cut, plumbed and bolted in position. The next thing to do is to run in the plate rails at the top. First lay on the one running across the rear and then lay on the two at the sides. These may be marked and worked to proper curvature, after which they are anchored in place. The next thing to do is to proceed with the setting of all other posts, starting with the door posts, at A, Figure 2, and proceeding toward the rear on each side. It will be noted that there are a number of other posts showing in Figure 5, at the corner. These posts are made from white pine,

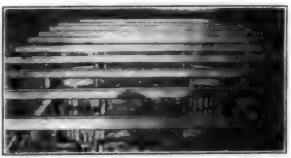


Fig. 6. Method of framing in rafters or roof bows.

spruce or other very light lumber and are set in merely to give the form of the body. An alternate method of securing the curvature at the rear quarter consists of running several curved slats in a horizontal direction. This method was used to give shelf room if cupboards were built into these corners later. In framing in the windows and the rafters, the rafters are placed one foot on centers and are made from ⅞" stock and vary from 1¼" in width at the outer end to 2" in width at the center. Figure 6 shows how these rafters are fitted into the plate rail. The plate rail is in reality a double rail, a dummy section being laid in on top of the main rail.

Fig. 7. Front quarter view of the body frame.

The second part of this article will appear in the May issue. In it Mr. Kuns explains how the fabric is applied to the body frame, and how the interior arrangements are planned.

Small Lever Opens Top of Convertible Sedan

ENGLISH motorists driving the latest type of automobile need only turn a small lever beside the driver's seat and the family sedan will be converted into a semi-open car. The photo shows how the lever installation is made and how it can easily be operated by the driver. A chain and lever device transmits the power of the lever to the leather top of the sedan. Two small rollers carry the leather portion toward the rear of the car and leave the car roof completely open.

The most valuable feature of this new convertible sedan is the fact that it can be either a tightly closed car, for winter use or completely open for the summer days.

TRY CROSS-CHANNEL TAXI

AN AIRPLANE taxi service across the English channel, as distinguished from the regular cross-channel flying service, is being tried between Calais and Dover by a French company. Small four-seater planes are used. The price is $12 a seat. Reservations are obtainable at the offices on either side of the channel, or at any travel agency.

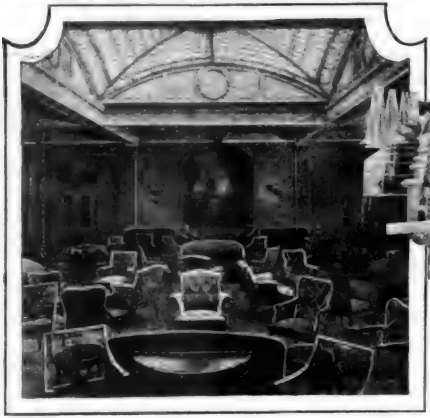
METAL CULVERTS MAKE UNIQUE GARAGE

GOVERNMENT officials recently found a novel use for some old metal culvert pipes that had accumulated at one of the Federal Reservations. By cutting out a portion of the culvert and mounting the remainder on piling about four feet high, an excellent automobile garage was built for the cars and trucks belonging to the post. These stalls are large enough for big army transport trucks.

Garage shelters made from old metal culverts have been erected by government officials to save garage building expense.

Largest American Liner Launched

S. S. Virginia Enters Pacific Tourist Service



The saloon of the Virginia, largest vessel ever built in America, is shown at the left.

SISTER ship of the S. S. California, the Virginia pictured below has just been launched and has successfully gone through rigid trials in Eastern waters.

The new ship is to be used in the Panama canal coast to coast service, and is electrically driven. Turbo generators drive large electric propelling motors. Controls may therefore be effected from the bridge electrically.

Equipped as it is with the latest in modern navigating service, the Virginia is one of the safest of modern ocean going passenger vessels. Non-fouling life boat launching devices are included.

The ship is capable of making 17 knots, and completes the New York to California trip in less than two weeks.

The S. S. Virginia, oil burning, turbo electric drive, is capable of a sustained speed of 17 knots. Partially enclosed promenade deck gives comfort in all kinds of weather.

Air Freight Insured for $1,000,000

SAID to be the first piece of trans-Atlantic air freight in history, the miniature model air purifier, shown at the left in the hands of Joan Crawford, film star, has been insured by officials of a motion picture company for $1,000,000. Of course, the model did not cost anywhere near this amount, but has been insured for that sum because of its historic importance. It was carried by the airplane Bremen, which still holds the record as being the only airplane to successfully cross the North Atlantic from east to west.

SEARCHLIGHTS DRESS UP HOLLYWOOD

HOLLYWOOD, home of the movies, believes in looking its best at all times. The photo below shows a novel night view of Hollywood in which a number of searchlights are sweeping across the dark sky of the main street to liven up a recent civic celebration.

PLANES WITH QUARTER-MILE WINGS PREDICTED

THE flying boat of the not distant future will be a monoplane with a wing spread of a quarter mile, with engines powerful enough for an ocean liner, and as luxuriously equipped as the finest ocean greyhounds. A speed of 100 miles an hour will be maintained, cutting the time required in crossing the Atlantic to about one day, as compared with the 7 days now needed by the average steamship.

These predictions were made recently by Clyde V. Cessna, a well known airplane engineer who has been building planes for 18 years. He asserts that these giant seaplanes are an inevitable development of the future.

Searchlights cutting across the night sky formed an arresting background for a celebration recently staged at Hollywood, home of the movies.

CARTER of the Red

by EDGAR RICE BURROUGHS, *Author of "Tarzan"*

Mars, the red planet, is the scene of this latest masterpiece from the charmed pen of Edgar Rice Burroughs. In this astonishing new serial of weird adventure, John Carter braves incredible dangers to breathe new life into the dying world of Mars. Begin the story now!

MY NAME is John Carter; I am better known as Captain Jack Carter, of Virginia. At the close of the Civil War I found myself possessed of several hundred thousand dollars (Confederate) and a captain's commission in the cavalry arm of an army which no longer existed; the servant of a state which had vanished with the hopes of the South. Masterless, penniless, and with my only means of livelihood, fighting, gone, I determined to work my way to the southwest and attempt to retrieve my fallen fortunes in a search for gold.

I spent nearly a year prospecting in company with another Confederate officer, Captain James K. Powell of Richmond. We were extremely fortunate, for late in the winter of 1865, after many hardships and privations, we located the most remarkable

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The foremost vessel swung broadside toward us, returning the terrific volley which the green Martian warriors fired from the windows of the buildings.

gold-bearing quartz vein that our wildest dreams had ever pictured.

As our equipment was crude in the extreme we decided that one of us must return to civilization, purchase the necessary machinery and return with a sufficient force of men properly to work the mine.

On March 3, 1866, Powell and I packed his provisions on two of our burros, and bidding me good-bye, he mounted his horse, and started down the mountainside toward the valley, across which led the first stage of his journey.

Some half hour later I happened to glance casually across the valley and was much surprised to note three little dots in about the same place I had last seen my friend and his two pack animals. I am not given to needless worrying, but the more I tried to convince myself that all was well with Powell, and that the dots I had seen on his trail were antelope or wild horses, the less I was able to assure myself.

Finally I could endure the suspense no longer, and, arming myself with my two Colt revolvers and a carbine, I strapped two belts of cartridges about me and catching my saddle horse, started down the trail taken by Powell in the morning.

As soon as I reached comparatively level ground I urged my mount into a canter and continued this, where the going permitted, until, close upon dusk, I discovered the point where other tracks joined those of Powell. They were the tracks of unshod ponies, three of them, and the ponies had been galloping.

I was positive now that the trailers were Apaches and that they wished to capture Powell alive for the fiendish pleasure of the torture, so I urged my horse onward at a most dangerous pace, hoping against hope that I would catch up with the red rascals before they attacked him.

Further speculation was suddenly cut short by the faint report of two shots far ahead of me. I knew that Powell would need me now if ever, and I instantly urged my horse to his topmost speed up the narrow and difficult mountain trail.

I had forged ahead for perhaps a mile or more without hearing further sounds, when the trail suddenly debouched onto a small, open plateau near the summit of the pass. I had passed through a narrow, over-

hanging gorge just before entering suddenly upon this table land, and the sight which met my eyes filled me with consternation.

Pursued by Apaches

THE little stretch of level land was white with Indian tepees, and there were probably half a thousand red warriors clustered around some object near the center of the camp.

In this instance I was, of course, positive that Powell was the center of attraction, but whether I thought or acted first I do not know, but within an instant from the moment the scene broke upon my view I had whipped out my revolvers and was charging down upon the entire army of warriors, shooting rapidly, and whooping at the top of my lungs. Single handed, I could not have pursued better tactics, for the red men, convinced by sudden surprise that not less than a regiment of regulars was upon them, turned and fled in every direction for their bows, arrows, and rifles.

The view which their hurried routing disclosed filled me with apprehension and with rage. Under the clear rays of the Arizona moon lay Powell, his body fairly bristling with the hostile arrows of the braves. Riding close to him I reached down from the saddle, and grasping his cartridge belt drew him up across the withers of my mount.

The Indians had by this time discovered that I was alone and I was pursued with imprecations, arrows, and rifle balls. The fact that it is difficult to aim anything but imprecations accurately by moonlight, that they were upset by the sudden and unexpected manner of my advent, and that I was a rather rapidly moving target saved me from the various deadly projectiles of the enemy and permitted me to reach the shadows of the surrounding peaks before an orderly pursuit could be organized.

I had gone but a short distance further when what seemed to be an excellent trail opened up around the face of a high cliff. The trail was level and quite broad and led upward and in the general direction I wished to go.

I had followed this trail for perhaps a hundred yards when a sharp turn to the right brought me to the mouth of a large cave. The opening was about four feet in height and three to four feet wide, and at this opening the trail ended.

Dismounting, I laid Powell upon the ground, but the most painstaking examination failed to reveal the faintest spark of life.

Leaving Powell's body where it lay on the ledge I crept into the cave to reconnoiter. I found a large chamber, possibly a hundred feet in diameter and thirty or forty feet in height; a smooth and well-worn floor, and many other evidences that the cave had, at some remote period, been inhabited.

As I was continuing my examination I commenced to feel a pleasant drowsiness creeping over me which I attributed to the fatigue of my long and strenuous ride, and the reaction from the excitement of the fight and the pursuit.

I Leave the Earth

A SENSE of delicious dreaminess overcame me, my muscles relaxed, and I was on the point of giving way to my desire to sleep when the sound of approaching horses reached my ears. I attempted to spring to my feet but was horrified to discover that my muscles refused to respond to my will. I was now thoroughly awake, but as unable to move a muscle as though turned to stone. I lay facing the opening of the cave and where I could see the short stretch of trail which lay between the cave and the turn of the cliff around which the trail led.

Until possibly midnight all was silence, the silence of the dead; then, suddenly, an awful moan broke upon my startled ears, and there came again from the black shadows the sound of a moving thing, and a faint rustling as of dead leaves. The shock to my already overstrained nervous system was terrible in the extreme, and with a superhuman effort I strove to break my awful bonds. It was an effort of the mind, of the will, of the nerves; not muscular, for I could not move even so much as my little finger, but none the less mighty for all that. And then something gave, there was a momentary feeling of nausea, a sharp click as of the snapping of a steel wire, and I stood with my back against the wall of the cave.

And then the moonlight flooded the cave, and there before me lay my own body as it had been lying all these hours, with the eyes staring toward the open ledge and the hands resting limply upon the ground.

The transition had been so sudden and so unexpected that it left me for a moment forgetful of aught else than my strange metamorphosis. My first thought was, is this then death! Have I indeed passed over forever into that other life! But I could not well believe this, as I could feel my heart pounding against my ribs from the exertion of my efforts to release myself from the anaesthesis which had held me.

Unable longer to resist the temptation to escape this horrible place I leaped quickly through the opening into the starlight of a clear Arizona night. The crisp, fresh mountain air outside the cave acted as an immediate tonic and I felt new life and new courage coursing through me. Pausing upon the brink of the ledge I upbraided myself for what now seemed to me wholly unwarranted apprehension.

As I stood thus meditating, I turned my gaze from the landscape to the heavens where the myriad stars formed a gorgeous and fitting canopy for the wonders of the earthly scene. My attention was quickly riveted by a large red star close to the distant horizon. As I gazed upon it I felt a spell of overpowering fascination—it was Mars, the god of war, and for me, the fighting man, it had always held the power of irresistible enchantment. As I gazed at it on that far-gone night it seemed to call across the unthinkable void, to lure me to it, to draw me as the lodestone attracts a particle of iron.

My longing was beyond the power of opposition; I closed my eyes, stretched out my arms toward the god of my vocation and felt myself drawn with the suddenness of thought through the trackless immensity of space. There was an instant of extreme cold and utter darkness.

The World of Mars

I OPENED my eyes upon a strange and weird landscape. I knew that I was on Mars; not once did I question either my sanity or my wakefulness. My inner consciousness told me as plainly that I was upon Mars as your conscious mind tells you that you are upon Earth.

I found myself lying prone upon a bed of yellowish, moss-like vegetation which stretched around me in all directions for interminable miles.

It was midday, the sun was shining full upon me and the heat of it was rather intense upon my naked body, yet no greater than would have been true under similar conditions on an Arizona desert. Here and there were slight outcroppings of quartz-bearing rock which glistened in the sunlight; and a little to my left, perhaps a hundred yards, appeared a low, walled enclosure about four feet in height.

Springing to my feet I received my first Martian surprise, for the effort, which on Earth would have brought me standing upright, carried me into the Martian air to the height of about three yards.

Instead of progressing in a sane and dignified manner, my attempts to walk resulted in a variety of hops which took me clear of the ground a couple of feet at each step and landed me sprawling upon my face or back at the end of each second or third hop.

I was determined, however, to explore the low structure which was the only evidence of habitation in sight, and so I hit upon the unique plan of reverting to first principles in locomotion, creeping. I did fairly well at this and in a few moments had reached the low, encircling wall of the enclosure.

There appeared to be no doors or windows upon the side nearest me, but as the wall was but about four feet high I cautiously gained my feet and peered over the top upon the strangest sight it had ever been given me to see.

The roof of the enclosure was of solid glass about four or five inches in thickness, and beneath this were several hundred large eggs, perfectly round and snowy white.

Five or six had already hatched and the grotesque caricatures which sat blinking in the sunlight were enough to cause me to doubt my sanity. They seemed mostly head, with little scrawny bodies, long necks and six legs, or, as I afterwards learned, two legs and two arms, with an intermediary pair of limbs which could be used at will either as arms or legs. Their eyes were set at the extreme sides of their heads a trifle above the center and protruded in such a manner that they could be directed either forward or back and also independently of each other, thus permitting this queer animal to look in any direction, or in two directions at once, without the necessity of turning the head.

Most of these details I noted later, for I was given but little time to speculate on the wonders of my new discovery. I had seen that the eggs were in the process of hatch-

ing, and as I stood watching the hideous little monsters break from their shells I failed to note the approach of a score of full-grown Martians from behind me.

On such a little thing my life hung that I often marvel that I escaped so easily. Had not the rifle of the leader of the party swung from its fastenings beside his saddle in such a way as to strike against the butt of his great metal shod spear I should have snuffed out without ever knowing that death was near me. But the little sound caused me to turn, and there upon me, not ten feet from my breast, was the point of that huge spear, a spear forty feet long, tipped with gleaming metal, and held low at the side of a mounted replica of the little devils I had been watching.

But how puny and harmless they now looked beside this huge and terrific incarnation of hate, of vengeance and of death. The man himself, for such I may call him, was fully fifteen feet in height and, on earth, would have weighed some four hundred pounds.

Unarmed and naked as I was, the first law of nature manifested itself in the only possible solution of my immediate problem, and that was to get out of the vicinity of the point of the charging spear. Consequently I gave a very earthly and at the same time superhuman leap to reach the top of the Martian incubator, for such I had determined it must be.

My effort was crowned with a success which appalled me no less than it seemed to surprise the Martian warriors, for it carried me fully thirty feet into the air and landed me a hundred feet from my pursuers and on the opposite side of the enclosure.

The Green Men

I ALIGHTED upon the soft moss easily and without mishap, and turning saw my enemies lined up along the further wall. They were conversing together in low tones, and gesticulating and pointing toward me. Their discovery that I had not harmed the little Martians, and that I was unarmed, must have caused them to look upon me with less ferocity; but, as I was to learn later, the thing which weighed most in my favor was my exhibition of hurdling.

While the Martians are immense, their bones are very large and they are muscled only in proportion to the gravitation which they must overcome. My feat then was as marvelous upon Mars as it would have been upon Earth, and from desiring to annihilate me they suddenly looked upon me as a wonderful discovery to be captured and exhibited among their fellows.

They carried rifles of a white metal stocked with wood, which I learned later was a very light and intensely hard growth much prized on Mars, and entirely unknown to us denizens of Earth. The weight of these rifles is comparatively little, and with the small caliber, explosive, radium projectiles which they use, and the great length of the barrel, they are deadly in the extreme and at ranges which would be unthinkable on Earth.

The Martians, after conversing for a short time, turned and rode away in the direction from which they had come, leaving one of their number alone by the enclosure. When they had covered perhaps two hundred yards they halted, and turning their mounts toward us sat watching the warrior by the enclosure.

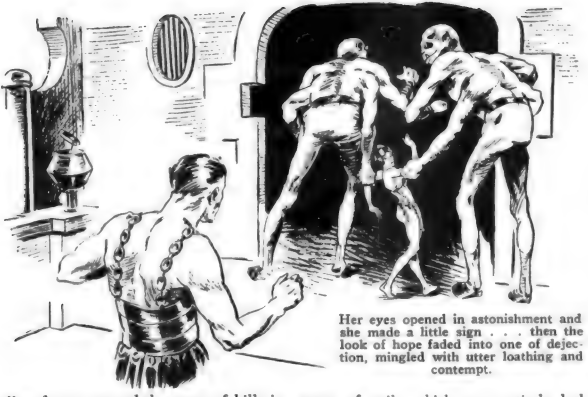
He was the one whose spear had so nearly transfixed me, and was evidently the leader of the band. When his force had come to a halt he dismounted, threw down his spear and small arms, and came around the end of the incubator toward me, entirely unarmed and as naked as I, except for the ornaments strapped upon his head, limbs, and breast.

When he was within about fifty feet of me he unclasped an enormous metal armlet, and holding it toward me in the open palm of his hand, addressed me in a clear, resonant voice, but in a language, it is needless to say, I could not understand.

Stretching my hand toward him, I advanced and took the armlet from his open palm, clasping it about my arm above the elbow; smiled at him and stood waiting. His wide mouth spread into an answering smile, and locking one of his intermediary arms in mine we turned and walked back toward his mount.

He exchanged a few words with his men, motioned to me that I would ride behind one of them, and then mounted his own animal. The fellow designated reached down two or three hands and lifted me up behind him on the glossy back of his mount, where I hung on as best I could by the belts and straps which held the Martian's weapons and ornaments.

The entire cavalcade then turned and



Her eyes opened in astonishment and she made a little sign . . . then the look of hope faded into one of dejection, mingled with utter loathing and contempt.

galloped away toward the range of hills in the distance.

The Ancient City

WE HAD gone perhaps ten miles when the ground began to rise very rapidly. We were, as I was later to learn, nearing the edge of one of Mars' long dead seas, in the bottom of which my encounter with the Martians had taken place.

In a short time we gained the foot of the mountains, and after traversing a narrow gorge came to an open valley, at the far extremity of which was a low tableland upon which I beheld an enormous city. Toward this we galloped, entering it by what appeared to be a ruined roadway leading out from the city.

Upon closer observation I saw as we passed them that the buildings were deserted, and while not greatly decayed had the appearance of not having been tenanted for years, possibly for ages. Toward the center of the city was a large plaza, and upon this and in the buildings immediately surrounding it were camped some nine or ten hundred creatures of the same breed as my captors.

With the exception of their ornaments all were naked. The women varied in appearance but little from the men. Their bodies were smaller and lighter in color, and their fingers and toes bore the rudiments of nails, which were entirely lacking among the males. The adult females ranged in height from ten to twelve feet.

As we neared the plaza and my presence was discovered we were immediately surrounded by hundreds of the creatures who seemed anxious to pluck me from my seat behind my guard. A word from the leader of the party stilled their clamor, and we proceeded at a trot across the plaza to the entrance of as magnificent an edifice as mortal eye has rested upon.

The building was low, but covered an enormous area. It was constructed of gleaming white marble inlaid with gold and brilliant stones which sparkled and scintillated in the sunlight. The main entrance was some hundred feet in width and projected from the building proper to form a huge canopy above the entrance hall. There was no stairway, but a gentle incline to the first floor of the building opened into an enormous chamber encircled by galleries.

On the floor of this chamber, which was dotted with highly carved wooden desks and chairs, were assembled about forty or fifty male Martians around the steps of a rostrum. On the platform proper squatted an enormous warrior heavily loaded with metal ornaments, gay-colored feathers and beautifully wrought leather trappings ingeniously set with precious stones.

Our party had halted at the entrance to the building, and at a sign from the leader I had been lowered to the ground. Again locking his arm in mine, we had proceeded into the audience chamber. There were few formalities observed in approaching the Martian chieftain. My captor merely strode up to the rostrum, the others making way for him as he advanced. The chieftain rose to his feet and uttered the name of my escort who, in turn, halted and repeated the name of the ruler followed by his title.

My captor, whose name was Tars Tarkas, was virtually the vice-chieftain of the community, and a man of great ability as a statesman and warrior. He evidently explained briefly the incidents connected with his expedition, including my capture, and when he had concluded the chieftain addressed me at some length.

Jumping Jack!

I REPLIED in our good old English tongue merely to convince him that neither of us could understand the other; but I noticed that when I smiled slightly on concluding, he did likewise.

The assembled warriors and chieftains examined me closely, feeling my muscles and the texture of my skin. The principal chieftain then evidently signified a desire to see me perform, and, motioning me to follow, he started with Tars Tarkas for the open plaza.

I did not, of course, know the reason for which we had come to the open, but I was not long in being enlightened. They first repeated the word "sak" a number of times, and then Tars Tarkas made several jumps, repeating the same word before each leap; then, turning to me, he said, "sak!" I saw what they were after, and gathering myself together I "sakked" with such marvelous success that I cleared a good hundred and fifty feet; nor did I, this time, lose my equilibrium, but landed squarely upon my feet without falling.

My exhibition had been witnessed by several hundred lesser Martians, and they immediately broke into demands for a repetition, which the chieftain then ordered me to make; but I was both hungry and thirsty, and determined on the spot that my only method of salvation was to demand the consideration from these creatures which they evidently would not voluntarily accord. I therefore ignored the repeated commands to "sak," and each time they were made I motioned to my mouth and rubbed my stomach.

Tars Tarkas and the chief exchanged a few words, and the former, calling to a young female among the throng, gave her some instructions and motioned me to accompany her. I grasped her proffered arm and together we crossed the plaza toward a large building on the far side.

My fair companion was about eight feet tall, having just arrived at maturity. Her name, as I afterward learned, was Sola, and she belonged to the retinue of Tars Tarkas. She conducted me to a spacious chamber in one of the buildings fronting on the plaza, and which, from the litter of silks and furs upon the floor, I took to be the sleeping quarters of several of the natives.

Sola motioned me to be seated upon a pile of silks near the center of the room, and, turning, made a peculiar hissing sound, as though signaling to some one in an adjoining room. In response to her call I obtained my first sight of a new Martian wonder. It waddled in on its ten short legs, and squatted down before the girl like an obedient puppy. The thing was about the size of a Shetland pony, but its head bore a slight resemblance to that of a frog, except that the jaws were equipped with three rows of long, sharp tusks.

The White Apes

SOLA stared into the brute's wicked-looking eyes, muttered a word or two of command, pointed to me, and left the chamber. I could not but wonder what this ferocious-looking monstrosity might do when left alone in such close proximity to such a relatively tender morsel of meat; but my fears were groundless, as the beast, after surveying me intently for a moment, crossed the room to the only exit which led to the street, and lay down full length across the threshold.

After a while, Sola returned bearing both food and drink. These she placed on the floor beside me, and seating herself a short way off regarded me intently. The food consisted of about a pound of some solid substance of the consistency of cheese and almost tasteless, while the liquid was apparently milk.

After I had eaten, I slept, nor did I awaken until daylight. The other occupants of the room, five in number, were all females, and they were still sleeping, piled

high with a motley array of silks and furs. Across the threshold lay stretched the sleepless guardian brute, just as I had last seen him on the preceding day; apparently he had not moved a muscle: his eyes were fairly glued upon me, and I fell to wondering just what might befall me should I endeavor to escape.

I have ever been prone to seek adventure and to investigate and experiment where wiser men would have left well enough alone. It therefore now occurred to me that the surest way of learning the exact attitude of this beast toward me would be to attempt to leave the room.

Slowly and carefully, therefore, I gained my feet, only to see that my watcher did the same; cautiously I advanced toward him, finding that by moving with a shuffling gait I could retain my balance as well as make reasonably rapid progress. As I neared the brute he backed cautiously away from me, and when I reached the open he moved to one side to let me pass. He then fell in behind me and followed about ten paces in my rear as I made my way along the deserted street.

Evidently his mission was to protect me only, I thought, but when we reached the edge of the city he suddenly sprang before me, uttering strange sounds and baring his ugly and ferocious tusks. Thinking to have some amusement at his expense, I rushed toward him, and when almost upon him sprang into the air, alighting far beyond him and away from the city. He wheeled instantly and charged me with the most appalling speed I had ever beheld.

I quickly saw that I would have difficulty in escaping the fangs of the beast on a straightaway course, and so I met his charge by doubling in my tracks and leaping over him as he was almost upon me. This maneuver gave me a considerable advantage, and I was able to reach the city quite a bit ahead of him, and as he came tearing after me I jumped for a window about thirty feet from the ground in the face of one of the buildings overlooking the valley.

Grasping the sill I pulled myself up to a sitting posture without looking into the building, and gazed down at the baffled animal beneath me. My exultation was short-lived, however, for scarcely had I gained a secure seat upon the sill than a huge hand grasped me by the neck from behind and dragged me violently into the room. Here I was thrown upon my back, and beheld standing over me a colossal ape-like creature, white and hairless except for an enormous shock of bristly hair upon its head.

Battle of the Brutes

THE thing, which more nearly resembled our earthly men than it did the Martians I had seen, held me pinioned to the ground with one huge foot, while it jabbered and gesticulated at some answering creature behind me. This other, which was evidently its mate, soon came toward us, bearing a mighty stone cudgel with which it evidently intended to brain me.

The cudgel was swinging in the arc which ended upon my upturned face when a bolt of myriad-legged horror hurled itself through the doorway full upon the breast of my executioner. With a shriek of fear the ape which held me leaped through the open window, but its mate closed in a terrific death struggle with my preserver, which was nothing less than my faithful watch-thing; I cannot bring myself to call so hideous a creature a dog.

As quickly as possible I gained my feet and backing against the wall I witnessed such a battle as it is vouchsafed few beings to see. My beast had an advantage in his first hold, having sunk his mighty fangs far into the breast of his adversary; but the great arms and paws of the ape, backed by muscles far transcending those of the Martian men I had seen, had locked the throat of my guardian and slowly were choking out his life.

Suddenly I came to myself and, with that strange instinct which seems ever to prompt me to my duty, I seized the cudgel, which had fallen to the floor at the commencement of the battle, and swinging it with all the power of my earthly arms I crashed it full upon the head of the ape, crushing his skull as though it had been an egg shell.

Scarcely had the blow descended when I was confronted with a new danger. The ape's mate, recovered from its first shock of terror, had returned to the scene of the encounter by way of the interior of the building.

I had turned to make for the window, but my eyes alighting on the form of my erstwhile guardian threw all thoughts of flight to the four winds. He lay gasping upon the floor of the chamber, his great eyes fastened upon me in what seemed a pitiful appeal for protection.

Without more ado, therefore, I turned to meet the charge of the infuriated bull ape. I had recourse to earthly tactics, and swinging my right fist full upon the point of his chin I followed it with a smashing left to the pit of his stomach. The effect was marvelous, for, as I lightly side-stepped, after delivering the second blow, he reeled and fell upon the floor doubled up with pain and gasping for wind. Leaping over his prostrate body, I seized the cudgel and finished the monster before he could regain his feet.

As I delivered the blow a low laugh rang out behind me, and, turning, I beheld Tars Tarkas, Sola, and three or four warriors standing in the doorway of the chamber. As my eyes met theirs I was, for the second time, the recipient of their zealously guarded applause.

My absence had been noted by Sola on her awakening, and she had quickly informed Tars Tarkas, who had set out immediately with a handful of warriors to search for me. As they had approached the limits of the city they had witnessed the actions of the bull ape as he bolted into the building, frothing with rage.

They had followed immediately behind him, thinking it barely possible that his actions might prove a clew to my whereabouts, and had witnessed my short but decisive battle with him.

Tars Tarkas and the other warriors were standing over the now rapidly reviving brute which had saved my life, and whose life I, in turn, had rescued. There seemed something menacing in their attitude toward my beast, and I hesitated to leave until I had learned the outcome. It was well I did so, for the warrior drew an evil-looking pistol from its holster and was on the point of putting an end to the creature when I sprang forward and struck up his arm.

I then knelt down beside the fearsome looking thing, and raising it to its feet, motioned for it to follow me.

I had at least two friends on Mars; a young woman who watched over me with motherly solicitude, and a dumb brute which, as I later came to know, held in its poor ugly carcass more love, more loyalty, more gratitude than could have been found in the entire five million green Martians who rove the deserted cities and dead sea bottoms of Mars.

Opening the Incubators

AFTER a breakfast, which was an exact replica of the meal of the preceding day and an index of practically every meal which followed while I was with the green men of Mars, Sola escorted me to the plaza, where I found the entire community engaged in watching or helping at the harnessing of huge mastodonian animals to great three-wheeled chariots. There were about two hundred and fifty of these vehicles, each drawn by a single animal, any one of which, from their appearance, might easily have drawn the entire wagon train when fully loaded.

As the cavalcade took up the line of march in single file, Sola dragged me into an empty chariot and we proceeded with the procession toward the point by which I had entered the city the day before.

Every one but myself—men, women, and children—were heavily armed, and at the tail of each chariot trotted a Martian hound, my own beast following closely behind ours; in fact, the faithful creature never left me voluntarily during the entire ten years I spent on Mars. Our way led out across the little valley before the city, through the hills, and down into the dead sea bottom which I had traversed on my journey from the incubator to the plaza. The incubator, as it proved, was the terminal point of our journey this day.

On reaching it the chariots were parked with military precision on the four sides of the enclosure, and half a score of warriors, headed by the enormous chieftain, and including Tars Tarkas and several other lesser chiefs, dismounted and advanced toward it. I could see Tars Tarkas explaining something to the principal chieftain, whose name, by the way, was, as nearly as I can translate it into English, Lorquas Ptomel, Jed; jed being his title.

Lorquas Ptomel grunted something at me, and turning to his warriors gave a few words of command relative to the incubator. They paid no further attention to me and I was thus permitted to remain close and watch their operations, which consisted in breaking an opening in the wall of the incubator large enough to permit of the exit of the young Martians.

On either side of this opening the women and the younger Martians, both male and female, formed two solid walls leading out through the chariots and quite away into

the plain beyond. Between these walls the little Martians scampered, wild as deer; being permitted to run the full length of the aisle, where they were captured one at a time by the women and older children.

The work of rearing young, green Martians consists solely in teaching them to talk, and to use the weapons of warfare with which they are loaded down from the very first year of their lives. Coming from eggs in which they have lain for five years, the period of incubation, they step forth into the world perfectly developed except in size.

Sola's duties were now doubled, as she was compelled to care for the young Martians as well as for me, but neither one of us required much attention, and as we were both about equally advanced in Martian education, Sola took it upon herself to train us together.

Her prize consisted in a male about four feet tall, very strong and physically perfect; also, he learned quickly, and we had considerable amusement, at least I did, over the keen rivalry we displayed. The Martian language, as I have said, is extremely simple, and in a week I could make all my wants known and understand nearly everything that was said to me.

Besieged From the Air

THE third day after the incubator ceremony we set forth toward home, but scarcely had the head of the procession debouched into the open ground before the city than orders were given for an immediate and hasty retreat. As though trained for years in this particular evolution, the green Martians melted like mist into the spacious doorways of the near-by buildings, until, in less than three minutes, the entire cavalcade of chariots, mastodons and mounted warriors was nowhere to be seen.

Sola and I had entered a building upon the front of the city, in fact, the same one in which I had had my encounter with the apes, and, wishing to see what had caused the sudden retreat, I mounted to an upper floor and peered from the window out over the valley and the hills beyond; and there I saw the cause of their sudden scurrying to cover. A huge craft, long, low, and gray painted, swung slowly over the crest of the nearest hill. Following it came another, and another, and another, until twenty of them, swinging low above the ground, sailed slowly and majestically toward us.

Each carried a strange banner swung from stem to stern above the upper works. I could see figures crowding the forward decks and upper works of the air craft. Whether they had discovered us or simply were looking at the deserted city I could not say, but in any event they received a rude reception, for suddenly and without warning the green Martian warriors fired a terrific volley from the windows of the buildings facing the little valley across which the great ships were so peacefully advancing.

Instantly the scene changed as by magic; the foremost vessel swung broadside toward us, and bringing her guns into play returned our fire, at the same time moving parallel to our front for a short distance and then turning back with the evident intention of completing a great circle which would bring her up to position once more opposite our firing line; the other vessels followed in her wake, each one opening upon us as she swung into position.

The fire from the vessels was most ineffectual, owing, as I afterward learned, to the unexpected suddenness of the first volley, which caught the ship's crew entirely unprepared and the sighting apparatus of the guns unprotected from the deadly aim of our warriors.

Twenty minutes after the first volley the great fleet swung trailing off in the direction from which it had first appeared. Several of the craft were limping perceptibly, and seemed but barely under the control of their depleted crews.

One by one, however, the ships managed to dip below the crests of the outlying hills until only one barely moving craft was in sight. This had received the brunt of our fire and seemed to be entirely unmanned, as not a moving figure was visible upon her decks. Slowly she swung from her course, circling back toward us in an erratic and pitiful manner.

As she neared the city the warriors rushed out upon the plain to meet her, but it was evident that she still was too high for them to hope to reach her decks.

She was drifting some fifty feet above the ground, followed by all but some hundred of the warriors who had been ordered back to the roofs to cover the possibility of a return of the fleet, or of reinforcements. It

(Continued on Page 185)

COO-COO Contraptions

Winners in Coo Coo Contraptions Contest No. 3 and rules for Contest No. 6 are printed below.

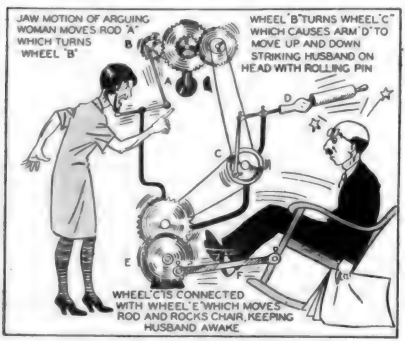
INTEREST in Modern Mechanics' Coo Coo Contraptions Contest continues at fever heat, to judge from the flood of entries which continue to pour in on the Coo Coo Editor—that is, the editor of the Coo Coo Contest. After hours of study of the various contraptions submitted in Contest No. 3, the Coo Coo Editor announces that the winners have been picked, and their names appear on this page. He also announces that Contest No. 6 is now in full swing and will continue open to all comers until the closing date, May 1, 1929.

As an example of a prize winning Coo Coo Contraption, study the "Silent Alarm" on the opposite page, which won first prize of $25 for Herbert Robinson of 1610 South 23rd Street, Tacoma, Washington. The drawing is Mr. Robinson's own, and it was so well executed that the contest editor has printed it just as the author submitted it. Bear in mind, however, that it is not necessary to make a sketch of your Coo Coo contraption unless you wish to—all that is required is a clearly written description. The main idea is to make your contraption as funny as you can.

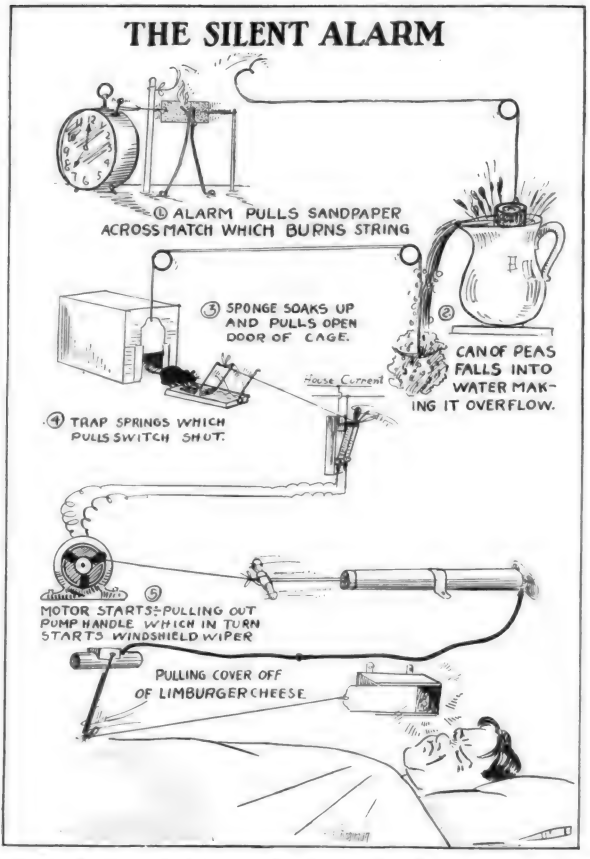
The United States Patent Office refuses to grant a patent on a perpetual motion machine, but that doesn't mean a thing to the contest editor. He has awarded second prize to Adam E. Sieminski of Sawyerville, Pa., for his perpetual motion machine diagrammed on this page. The editor couldn't find much of anything wrong with Mr. Sieminski's device; it certainly ought to work. Anyhow, he gets the second prize of $10.

Five third prizes of $3 each were awarded to the following contestants, whose contraptions ranged all the way from automatic fly exterminators to self-energized back scratching machines. Names of the winners are: Jack Skalicky, 1911 K Street W., Cedar Rapids, Iowa; Dick Darby, Box 254, Clawson, Michigan; John A. Morales, Box 544 Ancon, Canal Zone; John H. Knicely, 718 Troost Ave., Kansas City, Mo.; and K. L. Fisher, 208 S. Maryland Avenue, Ashley, Wilmington, Del.

In Contest No. 6, announced herewith, the regulations are as follows: Prizes will total $50—a first prize of $25, second prize $10, and five third prizes of $3 each. Closing date is May 1, 1929. Manuscripts received after this date will automatically be entered in Contest No. 7. No manuscripts will be returned; if you wish to preserve your contraption, be sure to keep a copy. In case of a tie for any of the prizes, duplicate prizes will be awarded to each of the tying contestants. The contest is open to anyone except employees of Fawcett Publications, Inc. It is not necessary to be a subscriber to Modern Mechanics; copies of the magazine are available at schools and public libraries.



This perpetual motion machine won second prize of $10 for Adam E. Sieminski in Coo Coo Contraptions Contest No. 3. It seems to work!



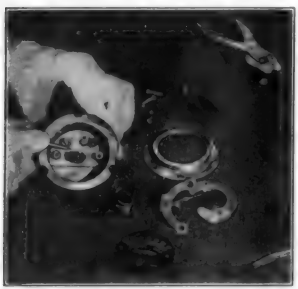
Here is one of the finest early rising alarms the Coo Coo Contest editor has yet seen. The contraption won first prize of $25 for Herbert Robinson of Tacoma, Washington. Start at figure 1 and see how it works! The drawing was made by Mr. Robinson himself, and he says that although his cheese-sniffing alarm has a few limitations, it's mighty effective.

Charles Magee Adams, editor of this department, whose photo appears in the box at the right, is an "old timer" in the radio field whose advice is eagerly sought by thousands of fans throughout the country. His department is a regular monthly feature of Modern Mechanics.

Adapting an Auto Ammeter for Radio Use

AN AUTOMOBILE dashboard ammeter in its usual form is not satisfactory when used to indicate the rate of charge or discharge of a radio "A" battery because of the small deflection of the pointer. A simple alteration, however, will convert such an ammeter into an extremely useful instrument for measuring currents of two or three amperes, or less.

An automobile ammeter usually registers up to 30 amperes in two-ampere steps. Changing it so that small currents can be measured more accurately requires only the winding and installing of a small coil.



The above photo shows an auto ammeter disassembled for adaptation to radio use.

When the ammeter is taken apart by removing the glass, dial, magnet, and pointer assembly, it will be found that a coil of a few turns of heavy enameled wire is connected between the two terminals. When an electric current flows through this coil, a magnetic field is set up and acts on a small permanent magnet fastened to the pointer shaft. The substituting of a coil of smaller wire with a greater number of turns causes a stronger field and a correspondingly greater pointer deflection for a given current.

The ammeter reading for a certain current is proportional to the number of turns in the coil. Thus, if a coil of eight turns carrying 20 amperes causes a certain deflection, a coil of 80 turns carrying a current of two amperes will cause the same deflection. This size coil, when the ammeter is used with a two-ampere charger, will cause the hand to stand at 20, so that all scale readings should be divided by ten to give the correct current. The new coil should be wound with wire not smaller than No. 18, enameled. If possible, the ammeter should be calibrated with a standard instrument. Changes in the amount of deflection can be made by moving the coil slightly towards or away from the pointer shaft magnet.

Any dealer in old auto parts will supply an ammeter at very reasonable cost, and you will find the adapted instrument useful for radio use.

Loudspeakers in the form of bowls which, at a slight distance, seem to be ordinary dishes, are becoming popular. The bowls can be tinted any desired shade, and except for the sound "portholes" in the sides follow the conventional shapes of everyday chinaware.

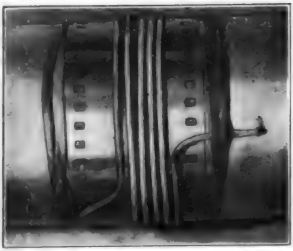
Old Film Useful in Making Radio Coils

RADIO constructors who attempt the making of their own "air-wound" or "space-wound" coils such as those recommended for short-wave work often are at a loss to know how the windings can be rigidly supported. A simple method which was found to work well requires only a quantity of sheet celluloid such as that obtained when the gelatine coating is removed from photographic film, and a little collodion, obtainable at a drug store.

First the film is soaked in warm water until the gelatine is soft and can be scraped off with a knife. Care must be taken to remove all gelatine from both sides of the film, as its presence in a coil would be undesirable because of its moisture-holding properties. If moving picture film is used, but one side need be scraped, because the back is uncoated.

The cleaned film is wound around a bottle or other cylindrical coil form, the excess length cut off, and the ends cemented together with collodion. A strip of paper wound beneath the film will facilitate its later removal from the form. The wire is next wound on, the required number of turns being placed over the celluloid. In starting the winding, the end of the wire is held with a rubber band or with a little collodion. Spacing is best obtained by winding a cord, of about the same diameter as the wire, between turns. This cord is then unwound as the turns are cemented to

Applying collodion to the windings of a short wave coil, as the spacing cord is removed. A glass jar is here used as a form.



A coil cemented in place to a moving picture film base, before removal from the form.

the celluloid. Collodion is applied in drops between the turns, and allowed to adhere to the insulation and the celluoid base. It should be applied in four or five places about the circumference of each turn. When the entire coil is completed, loose places can be cemented. The outside turns should be given extra care, for the sake of added strength. When the coil is completed and the collodion has thoroughly set, the unused portion of the celluloid can be trimmed away.

A word about the use of collodion is not out of place here. This substance is a solution of guncotton, or pyroxylin, in alcohol and ether, and is therefore very inflammable, and should be kept away from an open flame. If it is used in a poorly-ventilated room, it may cause some discomfort to the user. In the air the ether and alcohol evaporate rapidly, leaving a deposit of guncotton. Celluloid, being essentially guncotton and camphor, is easily

A completed coil, showing a suggested method of mounting so as to make it interchangeable with others.

cemented by it. In applying the collodion to coils, a toothpick is the best tool. The cemented turns will be found to be solid within one or two minutes. Collodion made flexible with castor oil should not be used.

A suggested mounting for coils of this type is shown. In this instance, No. 16 magnet wire was used, and was rigid enough to require only soldering to the terminals. The base consists of a strip of micarta with two phone-tips inserted through holes and held by soldered-on washers. The coil is mounted in a base made up from phone-tip jacks and micarta or other insulating material.

As for coil sizes, the following approximate values hold: Three turns—15-30 meters; eight turns—30-65 meters; fifteen turns—60-130 meters. These are for coils two inches in diameter, and used with a .00014 mf. condenser.

KEEP AERIAL AND GROUND LEADS SEPARATE

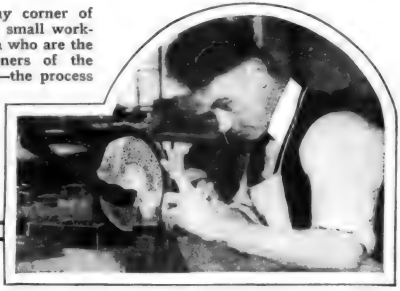
IT IS well known that an aerial wire and lead-in should be kept away from grounded metal objects, such as tin roofs and drains. But it is not so generally understood that for best results the aerial and ground leads should be separated from each other as far as practicable up to the point where they connect with the receiver.

At first thought it would seem sufficient merely to keep these two wires properly insulated from each other. However, radio frequency currents have a way of leaking across such ordinary insulation, thereby causing losses in the received signal. These are not great enough on strong local stations to make any appreciable difference in volume. But on weak distant stations they may easily be sufficient to make the desired station inaudible.

It is therefore important that the lead-in and ground wire be kept as far apart as feasible and never permitted to cross or come in contact with each other. Some engineers recommend that the spacing be as much as four or five feet. It may not be possible to do this, due to conditions encountered in particular installations. But with a little planning it will generally be possible to keep the two wires at least two or three feet apart, and when this can be done it will be found that the results on distance are much better than when the wires are run close together.

An Eight-Man Industry

IN AN out of the way corner of London there stands a small workshop employing eight men who are the only remaining practitioners of the ancient art of buhl craft—the process of inlaying gold and tortoise shell in wood. These photos show several of the artisans at work.



P. Spencer, one of the eight workmen, is shown above cutting an intricate pattern in the raw material. A skilled hand and an artist's eye are necessary to carve the delicate scrollwork patterns. It takes a man seven years to learn the secrets of the trade.

The proprietor of the only shop of its kind in the world, is shown above repairing an antique buhl inkstand from which much of the gold inlay has been worn away. Buhl craft developed in France under the reign of Louis XIV, and the art takes its name from that of its inventor, Andre Charles Boulle. Ivory, silver, gold and tortoise shell are the most common materials used in inlaying buhl furniture. Much of the work of present day buhl craftsmen is devoted to the repair of antique specimens, which are very valuable in the eyes of collectors.

Here is an antique buhl cabinet sent to the eight-man workshop for repairs. Note the elaborate inlaid patterns of the drawers.

Two actresses, Misses Grace Brinkley and Betty Comston, enjoy an indoor spin at a recent electrical show, in a car similar to the one described by Mr. Bates.

Building an Electric Auto

By JAMES BATES

EVERY junk yard has a few old automobiles in it that have good starting motors on them. You can get them for not much money and if you are a good buyer you can also get their batteries. If the batteries are in good shape you can make yourself a good little electric car. This will tell you how.

There are no springs in this little car. The spring is taken care of by the same system that the old Briggs and Stratton motor wheels were sprung on. There are six to eight birch strips which take the load and there is no need for steel springs. The wheels are the two and a half dollar kind you can get in any bicycle shop. The cost of them is so little that for these 18 by 2 inch wheels you cannot do better than to buy them there.

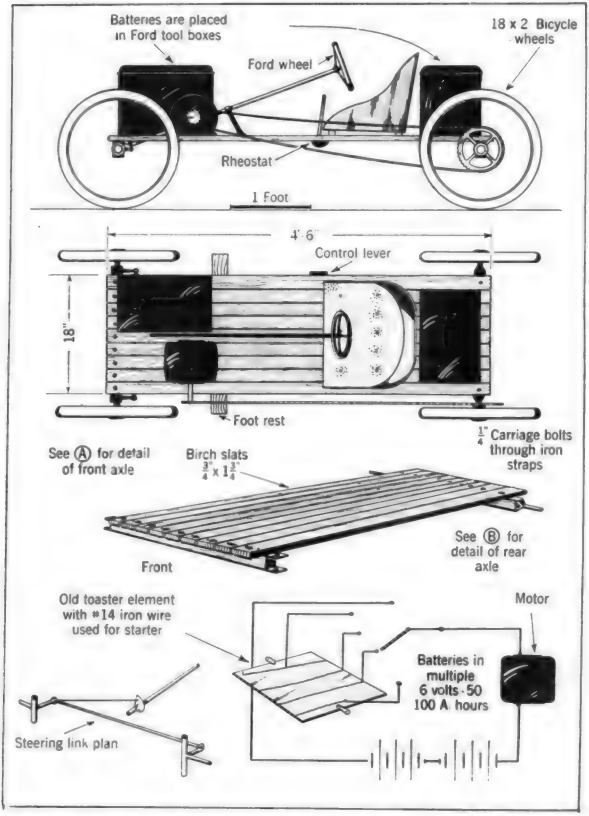
The front axle is made first. Take a fine piece of quarter sawed oak ½" by 2¼" and plane it square so that the sides are well protected from splintering, a thing which oak is apt to do, then fasten the strap irons on the top and the bottom as the drawings show. See that the axle has been sawed off first to the right length and squared. Then the strap irons are put on. They are drilled for the bolts and the bolts are screwed up tightly. The tape is put around the axles as the drawings show you how.

The king posts are made by your local blacksmith. It would be robbery if he should charge you more than a dollar each for the welding. You will see that the king post is nothing but an extra long bicycle axle welded to an upright.

The front axle is secured to the six lengths of birch slats that make the spring and frame of the car. These are ¾" by 2" and are rounded on the edges so that they cannot pinch the flesh. The rear axle is made just as the drawings show.

Take a piece of oak like the front axle is made of and see that it is just the length the drawing calls for. This is 24 inches long. The axle is welded as indicated.

Ford Batteries in Ford Tool Boxes Furnish Power for this "Kid" Auto



The extreme simplicity of this electric auto makes it an especially attractive car for boys. Using a couple of reclaimed storage batteries, and the motor from an old auto starter, any boy with a little ingenuity can construct a chassis to carry the power plant. Mr. Bates' suggested dimensions above will serve to guide you in adapting your ideas to the building of a simple car.

Many well known society people at the French resort Deauville indulge in pajama tours along the beach in cars similar to the one described here. Lord Michelem, above, considers the light electric the latest thing in small cars.

The nuts holding the bicycle type wheels on are locked with cotter pins to keep them from coming off.

Now, when the wheels are all on, there is the drive left to do. For this you will have to get a large bicycle sprocket, or better yet, get the drive from an old gear drive bicycle. There are usually one or two old ones in every old bike shop that the men will be glad to have you junk. Then you can make the kind of transmission that is shown in the car occupied by the young women at the head of the story.

Otherwise, you will have to run a long length of chain to the back axle. Any kind of a transmission will do that will let the motor turn up to about 1,500 revolutions. The wheel, to go about five miles an hour, has to go about 60 revolutions a minute. So figure it out so that the right gear ratio is obtained.

The body and the controls take a little ingenuity to fix. The best body is the kind shown in the drawing because you don't have to make any allowances for the bending of the birch springs. Just a simple seat is enough. House the batteries in Ford tool boxes.

One battery should be put in back. There are many of this kind of toy automobile about and they always use two batteries because when you use the batteries in multiple there isn't so much drain on them. It doubles their ampere hour capacity.

The seat can be the kind you buy for bike side cars in most any cycle shop, or you can make it yourself. The kind I show in the drawing is made from a sheet of aluminum the size shown.

The rear battery carrier is made of an old Ford tool box. These are just eighteen inches long and are the right length to go across the seat. The battery will go into them nicely.

The wiring diagram is a simple hook up. There is just a rheostat made from an old electric toaster and the switch is made as shown.

To start the car out on full speed would spoil the batteries in no time, but if they are fifty ampere hour batteries they should run the car for about seven to ten miles before a recharging should be needed. The rheostat will start the car up slowly and save the batteries.

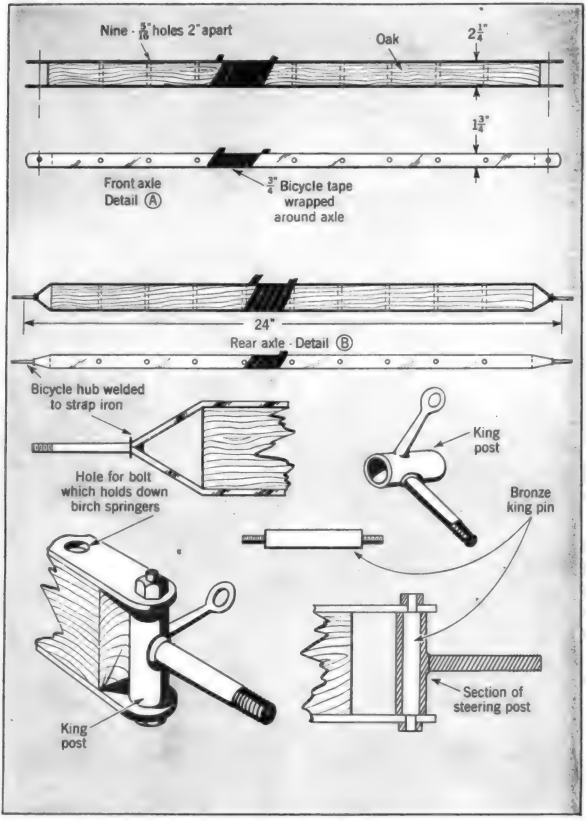
The steering connections are as indicated. This makes a sensitive way of steering and gives instant control.

The best way to care for the batteries is in this way: They should be rebuilt if you get them from the second hand man if they haven't been fixed after being in the old car. Most any old battery station will place a new grid on a battery and you can have them charged for a dollar each. That is the going rate for most stations, and I think that if you told the battery man what you wanted the battery for, he would be glad to give you the second hand plate for nothing or at most a very reasonable price. So ask him what he will do for you. You will find that it pays to bargain.

Keep the batteries full of water and they will always be charged. The little auto will be a good plaything for the man who builds it to give to some little friends of his, or he will himself find it fun.

Do not attempt to rig in a reverse as this will only burn out the motor. No starting motor is wound so that it will reverse without a different wiring and the whole rewind would be too expensive.

Illustrating How the Axles and Kingposts Are Built for Electric Car



The axles for the light electric play car can be made in the manner indicated by the drawings herewith. Oak, bound with strap iron and tape, makes a rigid, strong and durable axle. The rear piece hubs are welded to the top and bottom straps. The king posts are made from welded bicycle parts. Get your local blacksmith to do the welding. It is inexpensive.

Cheering Contraption Times Rah Rah Locomotive

The college Joes of various campuses always have a great time working football crowds into a frenzy. Novelty is their specialty. Here's a metronome for cheer sections built like a locomotive side crank.

GUARANTEED to wring enthusiastic rahs from football spectators, who knows but what this humble model of a locomotive cylinder might rally a faltering team through the cheers it elicits, thus saving the day for dear old Siwash?

This clever device was probably devised by some department of psychology working in conjunction with the engineering school. Used last year in football games near Baltimore, it is said to have produced more enthusiastic, well timed cheering than has ever been heard in those parts before.

The device is made of wood, and has handles along the bottom so that eight men can carry it from the gridiron to the field house. There is a wheel behind which a man stands, turning it with a crank, and each revolution is a signal for a hearty cheer from the undergraduates.

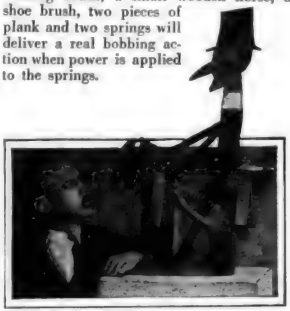
WAYSIDE SERMONS

REV. GEORGE RIDGLEY of Guisely, England, has recently constructed his wayside pulpit, pictured here, upon which pithy sentence sermons are flung to arrest the attention of passers by. A large signboard in front of his Baptist church carries these striking quotations which are changed daily, and the Reverend Ridgley has had more than one letter telling him of the inspiration his sermons furnished.

Research is being attributed to developing more wealth per day in these industrial times than the actual work performed in Factories, in the estimation of Owen Young of the General Electric Company. More and more, big executives are realizing that only through science will tomorrow's generation be provided for.

ECONOMY NAG FOR CAL

WILLIAM FANNING of Brooklyn, New York, calls his latest work "Economy Nag." He used Ex-President Coolidge seated on his mechanical horse for the subject of this expensive work, which he values at exactly $8.14. The horse which has been fashioned from a hammer head, a window washing brush, a small wooden horse, a shoe brush, two pieces of plank and two springs will deliver a real bobbing action when power is applied to the springs.



British Complete Largest and Fastest Submarine

A SUBMARINE so swift that it can match the speed of a destroyer has recently been built for the British navy. It bears the name X.I. and is shown in the photo at the right. It was designed as a commerce raider. Four 5.2 inch guns are mounted in swinging turrets, giving it an unusually powerful armament. A crew of 120 is required to man the ship, which is about three times the number of sailors needed to operate ordinary sized subs. The X.I. boasts a displacement of 8,600 tons and its powerful engines drive it at a 22-knot speed.

Above is shown the British Navy's new submarine X.I., the largest in the world.

HANDY ELECTRIC TOASTER

SANDWICHES with filling can easily be toasted on the new type electric toaster shown below, which clasps the bread in a frame which holds it flat over the heat grids.

Projections on the frame make it easy to turn over without touching the toast. The little device is entirely electrical and occupies a small space on a breakfast table.

EARTH'S CORE STUDIED

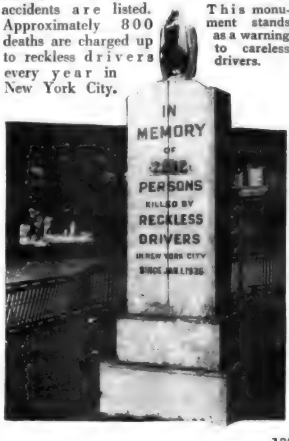
WITH the aid of marvelously delicate instruments geologists have been able to "see" 2,000 miles down into the heart of the earth. Instruments record earth tremors so delicately that scientists are able to determine the nature of the rocks through which the tremors passed. Information thus obtained is regarded by scientists as highly important.

An envelope 2,000 miles thick, composed of elastic rock, forms the outer crust of the earth, which rests upon a core 2,000 miles in radius, probably composed of iron and very heavy and inelastic. It is believed that the core is exceedingly hot and probably melted, and the tremendous pressure of the crust makes it inelastic. It is estimated that a pressure of 20,000,000 pounds per square inch is exerted on the core.

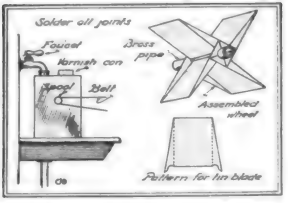
The latest theory of the formation of continents is that they are the result of geological "blisters" which occur when the heat of the earth's core tries to make its way to the outer crust.

TOMBSTONE TEACHES CAUTION

STANDING at a busy street intersection in the heart of New York City, where traffic is heavy, the monument shown below brings home to motorists the toll of human life exacted by reckless drivers. An interesting feature of the marker is the metal plate carrying the number of auto victims, which is changed every week as new victims of traffic accidents are listed. Approximately 800 deaths are charged up to reckless drivers every year in New York City.



This monument stands as a warning to careless drivers.



MAKING A MOTOR FROM A VARNISH CAN

THIS motor is made from a varnish can, some scrap tin and a short piece of small brass pipe. Ordinary water pressure will turn the paddle wheel so fast that you will not be able to grasp the shaft and stop it.

Procure some fairly heavy pieces of tin and cut the blades as shown, with the narrow end 1 inch less in width than the width of the can, and also 1 inch less in length than one half the breadth of the can. This will prevent rubbing. The wide end of the blades is 1½ inches longer than the narrow end and the edges are turned up at right angles for strength. The bends are made on the dotted lines. After bending you can also run a little solder along the inside of this angle to make the sides stiffer.

The brass tubing should be ¾-inch longer than the thickness of the can. Begin by soldering one blade in place, then solder the next in place, one quarter of the way around. Continue until the four blades are in place.

Now locate two points a little above the center of the varnish can, one on each side. They must be exactly the same distance from the top and the edges. Drill a hole at each point through the tin, about half the size of the diameter of the brass pipe. Then with a round iron rod, ream out the hole until it will make a snug fit for the brass pipe.

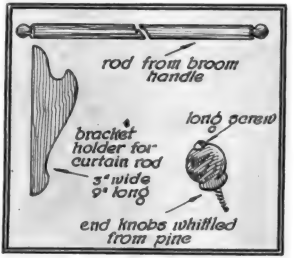
Next, cut out the bottom of the can. Spread the sides of the can to let the long brass shaft inside and work it up to the holes, then bring the ends of the pipe through them. If you now spin the wheel and it does not rub or bind in any place, the adjustments are correct. One or two washers put over each end of the pipe will prevent the sides of the blades from rubbing inside the can. When the wheel has been satisfactorily placed, solder a tin strip across the bottom of the can to prevent the sides from spreading.

The next step consists of mounting a pulley on the end of the brass pipe. You can set a smaller pipe inside the wheel shaft and solder this in place, then mount a spool on the smaller extension. Or you can build up a solid solder pulley wheel with grooved face for the belt and solder this right onto the end of the brass pipe.

HOME-MADE CURTAIN ROD

IT IS easy to make your own curtain rods and brackets for window drapes or door curtains. The rod itself is made from an old broom handle, with pine knobs, whittled out with a knife and screwed to the ends as shown in the diagram. The rod is then finished with sandpaper and enameled.

The brackets are 9 inches high and 3 inches wide, and are cut out with a scroll saw or key-hole saw. Use one inch pine material in cutting out the brackets. Fasten them to the wall with long screws at top and bottom. Be sure to make the notch at the top large enough to take the end of the rod, upon which the curtain is hung. Enamel the brackets to match the rod, using some color note that is in the hangings or room decorations.

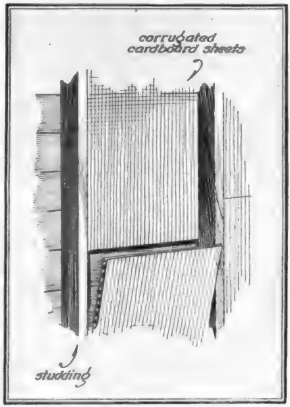


Handy Kinks for Home Work Shops

CORRUGATED CARDBOARD IS GOOD INSULATOR

CORRUGATED cardboard. cut in strips from boxes and packing cardboard, makes a good weather board and is an inexpensive insulation for farm buildings unfinished on the inside.

Usually cardboard boxes can be obtained at stores free of charge. Large boxes will provide pieces that can be trimmed to fit between studding, where they are fastened against the siding with small nails. Smaller pieces can be fitted together with the shears, and the cracks in the cardboard covered with paper tape.



BOTTLE PRESSURE TANK

NEED for air under slight but constant pressure comes up often in the home or experimental shop. You may need a steady blast of air for the little blast furnace, and other things.

A large-mouth bottle, cork, tubing and a rubber balloon will give you just such a supply. Get rubber tubing about one quarter inch in diameter and cement this in the mouth of the balloon with rubber cement. Use a bottle which has no sharp inside corners or edges, if possible. Make a hole through the center of the cork and run the tubing through. Then put the balloon inside the bottle and set the cork tightly.

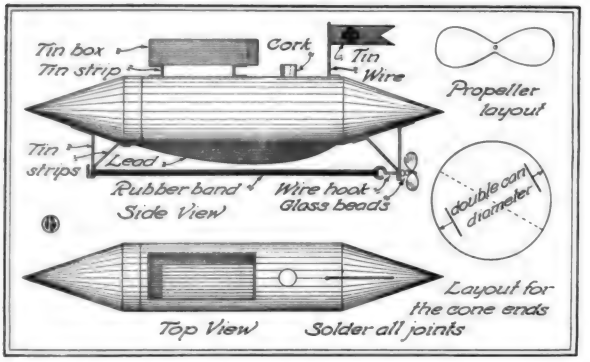
To stop the flow of air when it is not wanted, bend the tubing over and hold it with a clothes pin. You can blow up the balloon with your mouth. This causes the rubber to stretch until the bottle is coated inside with rubber. There cannot be any air leakage.

WOOD FINISHING

A HANDSOME dark brown tone can be imparted to oak wood by painting or stenciling it with white lime paint. Permit it to dry slowly in the shade, brush it off, and the brown hue will be permanently imparted to the wood. If certain portions of the wood are desired to be darker, a second application of the paint will produce the desired results. The lime must be applied evenly and must dry slowly to assure uniform coloring.

Large pores of oak usually look more or less smeary, depending on the amount of dust in the workshop. This difficulty may be eliminated by filling the pores with a paste made as follows: Take good wheat starch, pound it fine with a hammer, and stir into it a good strong polish by means of a wooden spatula. Take the resulting paste and work it into the pores of the wood by rubbing it crosswise of the grain. Permit it to dry for half an hour and then rub down the wood. If any open pores then remain, repeat the process. This filling of the pores saves much time and polishing in the finishing of the wood.

Toys You Can Make From Tin



TIN-CAN SUBMARINE IS GREAT PERFORMER

THIS submarine will travel or lie idle on the surface, move half submerged or glide along with only the conning tower showing. And by adding two simple tin wings it can be made to submerge, then rise to the surface again without touching it. A small tin propeller on a wire shaft which is attached to a stiff rubber band is the motor.

A baking powder can forms the hull of the ship. First of all remove all paper from the outside, put the cover on and solder it water tight. To make progress easier through the water, the ends are to be equipped with cones which reduce the resistance. These are made by cutting out a circle of tin twice the diameter of the can and cutting this into two equal halves, the cut being made on the dotted line shown. This is then shaped to form the cone, the edges soldered and the cones then soldered to each end of the can.

Make a small round hole in the top of the can and fit this with a cork. At the very bottom the keel, made from a strip of sheet lead, cut as shown, is soldered fast from one end to the other.

The power plant, which consists of the rubber band, wire shaft, propeller and glass beads, is supported underneath the hull by two pairs of tin strips attached as shown.

Use a 2-inch length of galvanized wire for the propeller shaft, forming a hook as shown in the front end. The propeller can vary in size, but a length of 2 inches and a width of about 1 inch will be suitable. Cut this out as shown by the pattern. The blades must be of the same design and, when the hole in the center is drilled, of the same weight. When the propeller exactly balances, solder it to the end of the wire shaft with two glass beads just in front of the propeller. Use a rubber band of good stiffness just long enough to pull slightly taut when it is hooked in place.

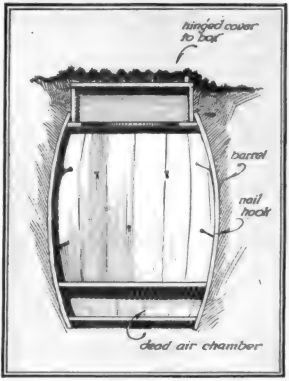
The conning tower can be any small, shallow box measuring about 2 inches wide and 4 inches long.

The secret of the maneuvers of this boat lies in the cork in the top. By having the interior filled entirely with air the boat will be very buoyant. Ballast may be either water or sand. It should ride normally about one third out of the water. Adding more water will lower the boat and you can submerge it entirely save for the conning tower.

BARREL AND BOX MAKE GOOD COOLER

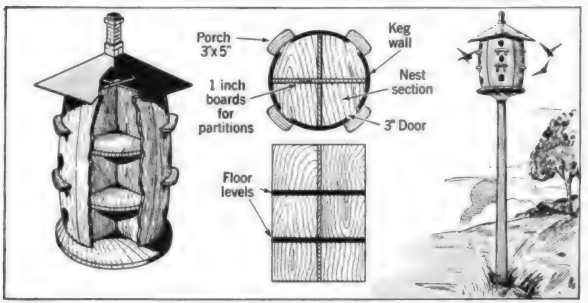
FOR summer cottages out in the wilds where ice is not accessible, the need of a refrigerator frequently makes itself felt. A simple refrigerator which serves the purpose admirably and has the additional advantage of costing practically nothing can be constructed from a barrel, a box and a few pieces of board. The diagram at the right shows a cross section of the back yard refrigerator.

Secure a stout barrel and build into it a false bottom about six inches above the real bottom. This forms a dead air chamber. Cut a square opening in the barrel head, leaving a ledge on which to mount a stout box of a size which will fit inside the overlapping edges of the barrel staves. The top of this box is hinged so that it may be opened at will. Now all that remains is to dig a hole and bury the refrigerator in it so that the top is level with the surface.

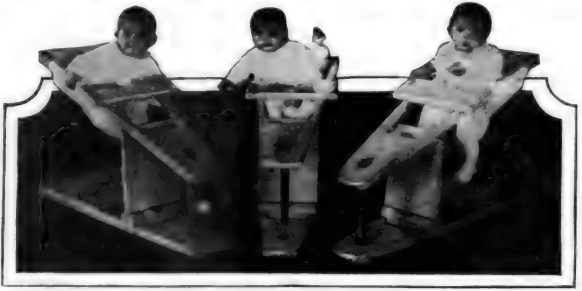


NAIL KEG MAKES MARTIN APARTMENT HOUSE

A GOOD martin house may be constructed from an old nail keg and a few boards. Partition off a third of the keg into four sections. This will require two boards crossing in the center. Close up this section by placing cross boards sawed to fit the circumference of the keg. The other two sections are made the same way but each should be given an eighth of a turn to "stagger" the entrances. Each of the four sections of the roof are sawed triangular to form a square-top when fitted together. Over them place roofing paper to make the roof water tight. Entrances 2½ or 3 inches in diameter should be made with brace and bit. They should be 1 to 2 inches above the floor. Porches 3x5 inches should be placed at each entrance.



Something New to Amuse the Growing Child



THESE "bouncing" babies are enjoying the new "Jimmy Jumper," a spring arrangement that resembles a see-saw. This new toy has been found an excellent medium for the amusement of the babies in the Infant Asylum at Kinsbridge Road and University Ave., the Bronx, New York City. All the infants in the asylum are less than a year old, which means that all toys must be safe and strong in construction.

The toy jumps with the slightest movement but will not turn over or injure the child in any way. It affords not only entertainment but exercise as well.

SALESMAN'S CAR IS TRAVELING ADVERTISEMENT

BY WAY of introducing something novel in traveling advertisements, a salesman in New York state has had a body built on his Ford car which symbolizes the line of shoes which he sells.

The body is built in the conventional manner, with a wood frame and sheet metal placed over it after having been beaten with a ball pen hammer into the desired curved shape.

The result is novel and striking, but it is not known whether merchants react to such schemes bordering on the bizarre. The tendency in this form of advertising seems to be to confine the symbolization to only one or more of the advertising company's cars.

This novel car body advertises a shoe salesman's product for him.

Petroleum Engineer Builds Ingenious Oil Well Model

WHAT does the bottom of an oil well look like?

Nobody is ever likely to find out through first-hand experience, of course. But an ingenious model has been constructed by a California petroleum engineer showing a reconstruction of an actual oil field. It is made up of particles of the strata brought up by the drilling bit and shows the types of materials encountered in sinking a well.

The model also shows the arched character of the strata, upthrust by movements of the earth into what geologists call an anticline. Oil fields are almost invariably associated with this type of underground structure. Black sands shown near the bottom of the model contain petroleum. The picture shows what would be exposed to view if a giant knife slash were cut through the earth.

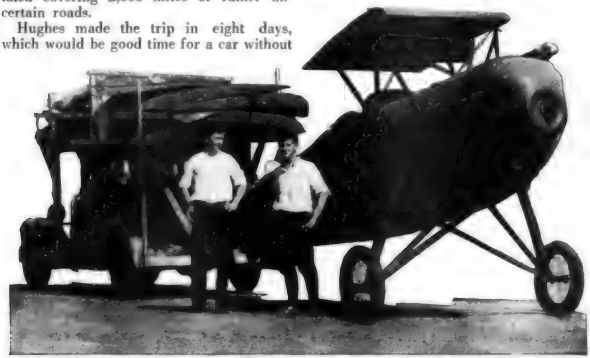
An ingenious model that shows the various earth strata which an oil well must penetrate before it can produce.

AUTO TOWS AIRPLANE 2,000 MILES

WHEN T. F. Hughes decided to establish an airplane service station in Fort Lauderdale, Florida, he packed all his belongings into his little sedan, placed the wings of his plane on top of the car, attached the tail section to the rear and was ready to move. The trip from Wheeling, West Virginia, to Fort Lauderdale necessitated covering 2,000 miles of rather uncertain roads.

Hughes made the trip in eight days, which would be good time for a car without any trailer. He had no mishaps on the trip, despite the fact that the heavy airplane fuselage had a tendency to skid on bad roads.

With the increasing popularity of the airplane for individual use, sportsmen favor the collapsible wing plane which can easily be towed on the highways.



Mr. T. F. Hughes, left, is shown beside the airplane that he transported 2,000 miles.

By JACK WOOLDRIDGE

All the world has heard of the successful endurance flight of the Question Mark. In this article Mr. Wooldridge, who was an eye-witness of the flight, points out how the horizon of commercial aviation has been broadened by the flight of the Question Mark.

SIX DAYS and six nights the giant, tri-motored Fokker monoplane *Question Mark* had been in the air. On the morning of the seventh day, the big gold-and-brown ship hummed rhythmically above Los Angeles, apparently in splendid condition. At 10 o'clock Lieut. Odas Moon in refueling ship No. 2 went up with 200 gallons of gas, delivered 170, lost 20 and returned to the Metropolitan airport.

An hour later, the left motor on the Fokker began sputtering and slowing down. From 1,500 revolutions per minute it sagged to 1,475. Then to 1,450. Sergeant Roy Hooe, official mechanic, went out along the 6-inch "cat walk" on the side of the plane. He worked feverishly with his tools. Still the r. p. m. sank. The engine was growing weaker.

Shortly after noon, the right motor coughed, sputtered and the whirl of its propeller slowed down. Again Sergeant Hooe went out along the "cat walk," slippery with oil and grease. Perhaps he could fix it.

Lieut. Moon arrived from the airport with more gas. But as the fuel flowed into the tank, the *Question Mark* further sagged. The Fokker could maintain altitude against the wind but when she turned with it, she slowly sank.

Sergt. Hooe shook his head sadly. The left motor was useless with frozen rocker-arms, the right motor dying.

"Dump the fuel!" signalled Major Carl Spatz, the flight commander.

The tanks were opened and the gasoline and oil sank in a misty spray. Then

Capt. Ira Eaker, Chief pilot, turned the nose of the ship downward and the craft landed with two of its motors stone dead.

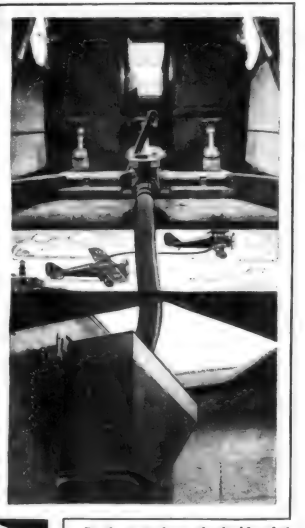
The world has read all about the feat of the *Question Mark* and its daring crew. One hundred and fifty hours, 40 minutes and 14 seconds in the air! Which is:

The world's record for continuous flight.

Two and one-half times as great as any previous record set by any airplane.

A day and a half longer than any sustained flight recorded by a powered balloon.

I walked around the crippled sky monarch when its last motor was silenced on the flying field. Rancid with the smell of burned oil and carbon, streaked with spattered fuel, littered inside with bits of food and wrappings from parcels, it reminded me of a tired animal which had done its best and wanted to be put away for a while.



In the top photo the inside of the fuselage of the refueling plane is shown, with the valve which sent the gasoline shooting through the hose to the Question Mark. The lower photo shows how the gas poured into a large funnel leading to the Question Mark's gas tank. At the left is a comprehensive inside view of the Question Mark.

The climax to the record flight came unexpectedly. Only the day before the end Capt. Bogart Rogers, one of the most widely known aviators in the West, had ventured the opinion that the ship might remain in the air for forty days.

"If it should become an endurance contest between flesh and metal," he said, "it's my guess that the motors will quit first."

Which is just what they did. Major Spatz with Capt. Eaker and Lieuts. Harry H. Halvorsen and Elwood R. Queseda, the latter relief pilots, were suffering more or less from ear strain as they climbed from the ship, due to the drone of the motor. Sergt. Hooe seemed a trifle dazed but recovered his equanimity within an hour or two.

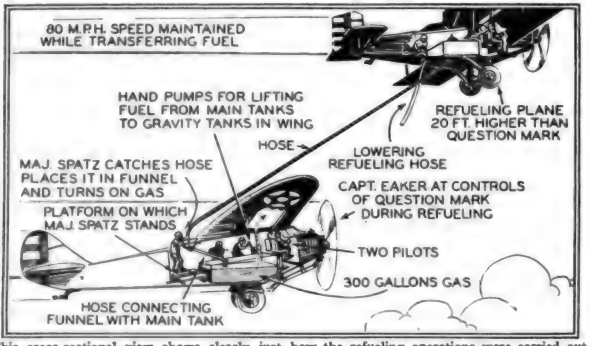
When, during the closing hours of the flight it was definitely determined that the great Fokker had broken all records, A. J. Adamson, official observer for the War Department, exuberantly wired to Secretary F. Trubee Davison:

"Only Elijah has gone further than the *Question Mark*."

To which the Secretary, who apparently is familiar with the Bible story of Elijah and his fiery chariot, replied:

"Good! Now let's trim Elijah."

But in a very few hours thereafter the plane was down and Elijah still holds the



This cross-sectional view shows clearly just how the refueling operations were carried out.

record for altitude, though not in a Fokker plane.

What a world of speculation the flight of the *Question Mark* opens! First, it sustains the practicability of re-fueling in the air. The two nursing planes made 33 trips up to the Fokker, delivering through a hose from 150 to 250 gallons of gas, at a time.

It would have been impossible, of course, for the ship to have carried this amount of fuel at its take-off. But, as Mr. Harris M. Hanshue, president and general of the Fokker Aircraft Corporation of America points out:

"The problem of non-stop air transport as far as mechanics is concerned, has thus been solved . . . Heretofore it has been demonstrated that a non-stop flight across America is feasible, but it has not been profitable from the commercial standpoint. The airplane to make such a long flight was required to carry such an excessively heavy load of gasoline and oil that there was no margin left for passengers, air mail or express. In other words, there could be no 'pay load.' Major Spatz and his associates in their remarkable endurance flight have demonstrated the means by which such long distance non-stop flights can be made successfully both from the financial and aeronautical standpoint.

"It has been proved that an airplane carrying a full load of passengers, can leave the Pacific Coast, refuel during the flight at convenient stations and continue on to the Atlantic without stop. The flight of

DATA ON THE QUESTION MARK'S GREAT FLIGHT

Start of flight—Jan. 1, 7:26.46 a.m.
End of flight—Jan. 7, 2:07.01 p.m.
Time in air—150 hours, 40 minutes, 15 seconds.
Distance in miles covered in flight—approximately 11,500.
Amount of gasoline consumed—5,205 gallons.
Amount of oil consumed—262 gallons.
Number of contacts made with re-fueling planes—about 36.
Tonnage of supplies and fuel transferred to plane—42,000 pounds.
Type of plane—Standard Army Fokker C-2 transport.
Wing Expansion—71 feet.
Type of motors—Standard Army Wright Whirlwinds.
Horsepower—225 each.
Average speed—70 miles.
Maximum speed—121 miles per hour.
Average altitude maintained—3,800; maximum 6,500.
Revolutions made by three motors—42,522,000.

The first successful refueling of an airplane in flight is shown in the above photo of Smith and Richter in their 37-hour endurance flight of Aug. 23, 1923, in which they broke existing records for time in the air. Major H. H. Arnold, Modern Mechanics' aviation editor, was one of the supervisors of the flight. He is shown in the circle giving Pilot Smith a last word of advice before taking off.

the *Question Mark* has shown the way to leave a weight margin for a 'pay load.'"

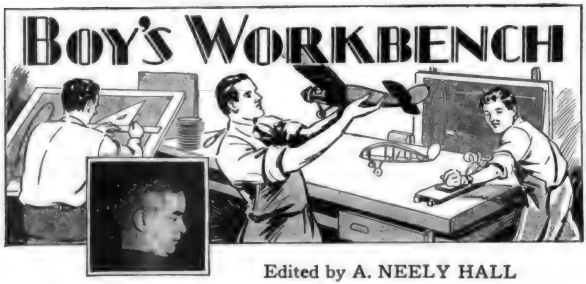
The second thing demonstrated by the *Question Mark* is that it is possible with present day motors to travel a distance equal to that of half-way around the world, by re-fueling. The big Fokker plane traveling at a speed ranging from 60 to 70 miles an hour, covered a total of approximately 11,500 miles in its 150 hours of travel.

In connection with the flight of the *Question Mark*, it is interesting to note that the first successful refueling of an airplane while in flight was accomplished in 1923 by Capt. Lowell Smith, later commander of the famous Round-the-world flight, and Lieut. J. P. Richter. Army DH planes were used in the test, which was carried out under the direction of Major H. H. Arnold, aviation editor of Modern Mechanics. The scene of the flight was Rockwell Field.

In this first of all refueling flights, the details had to be carefully planned, and much experimenting was done before it was decided to use a hose and a refueling plane, rather than attempt to pick up supplies from a ground catapult or other means.

Oil for the engines, being much heavier than auto oil, would not flow through the hose because of its viscosity. This difficulty was overcome by heating the oil, and the trial flights were ended—Smith and Richter were ready for the big attempt. They took off on Aug. 23, 1923, and landed 37 hours later, having broken all existing records for distance flown and time in the air without landing.

Several times the DH was refueled with extreme difficulty, owing to fogs which, on one occasion, made it necessary to refuel at an altitude of only 300 feet—scant skyroom in case of miscalculation. But the pilots had been trained to hold their ships steady, keeping the dangling hose with its heavy nozzle out of the path of whirling propellers, and the task was successfully completed. In all, 24 contacts were made by the refueling plane, and 680 gallons of gasoline and 38 gallons of oil were transferred. When Smith and Richter landed, they were hailed as pioneers of a new phase of flying, as indeed they were.



Edited by A. NEELY HALL

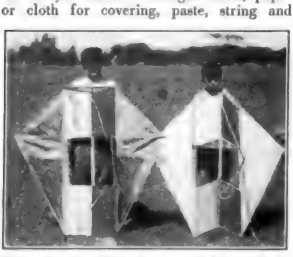
Spring is here, and the brisk winds make for ideal kite-flying weather. Mr. Hall presents plans this month for an unusually efficient kite, along with a scooter, wren hut and ship-model base which boys throughout the country will delight in making.

This Kite Will Lift a Camera Into the Air!

ADD THIS cloud chaser to your airport. She is about as hot a rig as I know of. She will lift a camera, a flag or any small object that you want to send aloft. And once you put her into high there is no trouble in keeping her there.

Yes, she is somewhat of a cross between a box kite and the old timer's hexagonal rig. She is called the Conyne (Co-9) after Silas J. Conyne, her inventor, and she is the type of kite used commercially for floating advertising banners in the breeze.

There is no great mystery about building the Conyne model. Straight sticks, paper or cloth for covering, paste, string and a little head work are all that are required. If ready-cut sticks are not available, rip what you need from a board with your ripsaw, or, better yet, with a circular saw. If you own one of those new "motorized workshops," or if you can gain permission to use the school saw, you will be in luck. Spruce or soft pine are the woods to use, unless you can get something lighter. Balsa, the wood airplanes have made famous, has won favor among kite mechanics, and bamboo is well liked. The advantage of bamboo is in its strength. A kite with a bamboo frame will fly in a wind that would snap pine sticks.

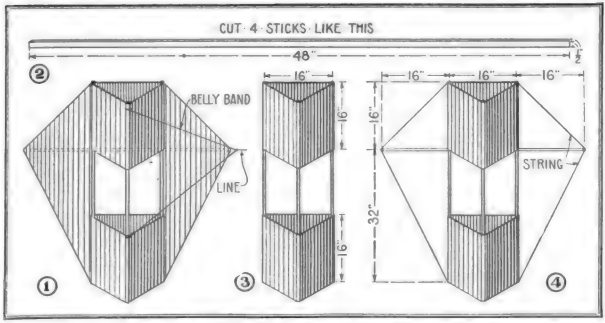


These Conyne kites are powerful enough to lift flags and small objects into the air.

Figure 1 shows a Conyne 4 feet long. If you want to build a larger model, notice that the four sticks are of equal length, and that the spacings are one-third of the length. If you use pine or spruce sticks, cut them of the width and thickness marked in Fig. 2, increasing this measurement a trifle for longer sticks.

A tough wrapping paper is all right for the covering, but cloth is more durable. Cambric is good and inexpensive. Maybe you can get pieces of different colors. Red for the upper cell, blue for the lower cell, and white for the side wings make a good combination.

First, frame the center cellular prism



Dimensions and details for constructing a Conyne kite.

with three sticks (Fig. 3). Cut the two bands of covering material 16 inches wide and 50 inches long. If cloth is used, cut it with the selvage along one edge, and allow ½ inch along the other edge for turning and gluing. Forming the bands is particular work. The sticks must be spaced equidistantly, 16 inches from center to center, and the paper or cloth must be stretched evenly so the surfaces will be smooth. Fasten the cloth with small tacks, or with glue or ambroid cement.

Fasten the horizontal stick across two of the vertical sticks, at the inner edge of the upper cell, with ends projecting equally, and lash the sticks together where they cross. Then you will be ready for the framing string. A light-weight fishing line is right for this. Cut a V-notch in each end of the three sticks, make half-hitches in the line and slip them over the stick ends. Pull the line taut, but not enough to bend the sticks.

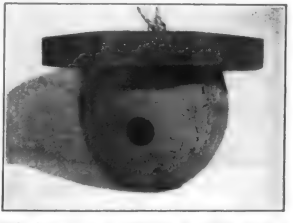
With the framing string in place, cover the side wings of the hexagonal plane, cutting two triangular pieces large enough to make a ½-inch lap over the string. Paste or glue the edges.

The points at which to attach the belly-band are shown in Fig. 1. Make the loop long enough so when it is pulled to one side it will come a trifle beyond the end of the horizontal stick. Attach the flying line with a non-slipping knot, at the point indicated.

WREN HUT MADE FROM A COCONUT SHELL

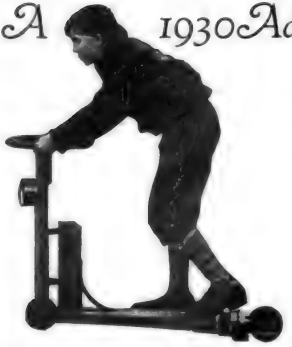
TO MAKE an ingenious coconut shell birdhouse, drill a ⅞-inch hole in the side of the shell for the doorway, and drain off the milk. Then cut away the top of the shell with a hacksaw, remove the meat and scrape the shell clean.

Make the roof octagonal, inscribing the octagon in an 8-inch circle, or make it 7 inches square. After cutting the board, sandpaper the edges, then paint it green or brown, and screw a screweye into its center for the wire hanger. Drill three or four holes through the top of the shell, slanting them so nails or screws can be driven through into the under side of the roof board.



This ingenious bird-house is made from a coconut shell sawed in half and mounted.

A 1930 Advance Model Scooter



IT'S ABOUT time to bring out your 1930 advance model scooter. The photograph suggests a job in the latest vogue, with long rakish body, equipped with "hotfoot" drive, positive quick-acting brake, automobile steering-wheel, short steering radius, permitting easy parking, clock-case type headlight, artillery, wire, disk or roller-skate wheels, optional. Complete specifications will be found in the accompanying diagrams.

Figure 1 shows the assembled job. The chassis has a 2-by-4 reach, with a 2-by-4 post mounted on the front, to which a 2-by-4 wheel fork is hinged. Cut the reach of the length marked, slot one end for the rear wheel fork, and bore a hole $\frac{3}{8}$-inch in diameter for a bolt axle (Fig. 9). The diameter of the wheel will determine the length of the slot and the location of the axle bolt hole. Cut the front post of the length indicated in Fig. 2, and saw a slot in each end to receive the front fork hinges. Mount the post upon the front of the reach, spiking through the reach into its end, and brace it with an iron shelf bracket (Figs. 1 and 3).

Figure 4 is a detail of the front fork. Slot the lower end for the front wheel, then continue a slot up the center of the piece to the height of the upper hinge. The size of the wheel will determine the length of the bottom slot, also the position of the bolt axle hole. If the wheel to be used exceeds 5 inches in diameter, fasten a slotted block of 2-by-4 to the front of the fork, and run the axle bolt through this block.

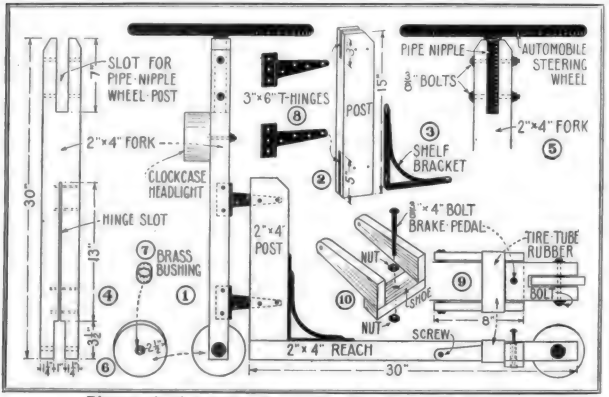


Diagram showing parts and assembly of an automobile scooter.

Cut a slot in the top of the fork, to receive the steering-wheel post. You can get an old automobile steering wheel for little or nothing at a garage, and an iron pipe nipple to fit the wheel hub, at a plumber's. Drill a hole through the wheel hub and the pipe nipple for a bolt, and drill two $\frac{3}{8}$-inch holes through the nipple and the 2-by-4 for bolts for mounting the wheel post.

The front fork hinges should be heavy. You may add a third hinge midway between the pair if you want to, for reinforcement. The hinges can be fastened with long screws.

The brake is shown in detail in Figs. 1, 9 and 10. The brake shoe is a wooden block $\frac{1}{2}$-inch thick, 2 inches wide and 6 inches long. It is hung from the 2-by-4 reach by two 8-inch hanger strips nailed to its ends and screwed to the sides of the 2-by-4. A bolt extending through the reach and the shoe, throws on the brake. A strip of rubber from a tire tube, extending over the reach, with ends tacked to the two shoe hangers, releases the brake. The hole in the reach must be enough larger than the pedal bolt, so the bolt will not touch the wood. The bolt must be connected to the brake shoe with a pair of nuts, one above and one below the shoe, with the lower nut countersunk flush with the surface of the shoe.

You will want a good paint job, of course. First apply a coat of outside house paint, then follow it with two coats of auto enamels, to make whatever color combination you want.

An old alarm clock with its glass held by the inner rim ring, the ring bolted to the case with small stove bolts, and the back of the case bolted to the wheel fork and pinned to the case, makes a good imitation drum headlight. Though, if you would carry a light, you might better substitute a bicycle lamp.

Old carbide lamps such as used to be used on motorcycles and automobiles some years ago can be picked up for a song at almost any wrecked car junk shop. With a little effort you can adapt one of these lights for use on your pushmobile—and it will really work! Or, if you prefer, a dry cell can be mounted on the steering column and connected up with a regular electric lamp.

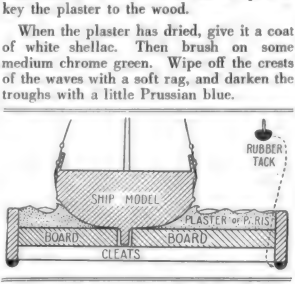
SHIP MODEL BASE

INSTEAD of mounting your ship model upon the conventional type of stand, set her afloat on a choppy sea. The photograph shows how Wenzel Vockel worked out the idea for a small brig.

Place the keel pocket off center, as shown in the diagram, so more water will show in front of the model than back of it. Use two boards of different width for the plaster base, and batten them together on the under side with two or three cleats, leaving $\frac{3}{4}$-inch between them for the keel pocket. Make the rim strips $\frac{1}{2}$-inch thick and $2\frac{1}{4}$-inches wide. Miter the ends, and fasten with glue and finishing nails.

The base looks best with the plaster filled to the top of the rim. To retard the drying of the plaster-of-Paris, so it will not set up before you have completed the modeling, add 1 part of a saturated solution of borax to each 12 parts of the water used for mixing the plaster. Drive large-headed tacks into the base several inches apart to key the plaster to the wood.

When the plaster has dried, give it a coat of white shellac. Then brush on some medium chrome green. Wipe off the crests of the waves with a soft rag, and darken the troughs with a little Prussian blue.



Cross-section showing details of model base.

Edited by WALTER D. KERST

In this department Mr. Kerst tells how to get the best results in amateur movie making and shows how novel effects of professional cameramen can be duplicated by the amateur. As an associate member of the Society of Motion Picture Engineers, Mr. Kerst is a nationally known authority in his field. He will gladly answer questions of movie making enthusiasts.

Silhouette Shots Make Home Movies "Different"

A NOVEL use of the amateur movie camera and a way to make home movies that are "different," is that of movie silhouettes. Entire little photoplays, comedy or drama, can be made by the veriest tyro, either indoors or out, and the results are fascinating to watch on the screen.

For indoor silhouettes, with artificial light, hang a sheet across a single or double open doorway. Be sure that the sheet is pulled taut, as wrinkles will show, and you will not have a background devoid of detail. The subject or subjects are placed two feet in front of the sheet, and your light source about 3 feet in back of it, in the next room, the purpose being to keep the background (or sheet) one even tone of white or light gray, while the side of the subject nearest the lens is in darkness. The arrangement is shown in Fig. 1.

Extinguish all lights in the room in which the camera is placed. It would be interesting to experiment with various types of lights and lighting effects. Try admitting a very weak light to the side of the subject nearest the lens, so as to just make the detail discernible. Another way is to throw your main light source, which is in back of the sheet, so that it just illuminates the edge of the subject. Different methods will suggest themselves as you progress.

The distance in front of the subject that the camera is to be placed will, of course, depend on whether you wish to make a large close-up, a medium shot, or a long, full figure shot. Use the widest lens opening. Try to keep your subjects in profile in as much of their action as possible. Have them tell their story by gesture.

A silhouette photoplay could be made with two or three characters. Have your plot action or continuity ready before you start. You can insert close-ups, medium shots, and long shots just the same as in your usual outdoor movie. In changing from scene to scene, use a fade-in and fade-out, so that the change will not be so abrupt. For a fade-in, shut your diaphragm to the smallest opening. Then, with your hand over the lens, start your camera and action, gradually removing your hand and slowly opening the diaphragm as far as it will go. The fade-out is accomplished by reversing this procedure. Keep in mind that in order to do this successfully the strength of your light will have to be such that at full lens opening you have just the right amount of light needed for the effect desired. When you start your fade-out, the light will gradually diminish on the film, as the diaphragm is closed.

As to the kind of lights to use, two 100

Showing Arrangements of Lights and Camera in Filming Silhouette

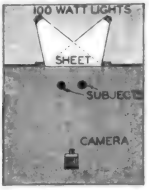


Figure 1

Figure 2

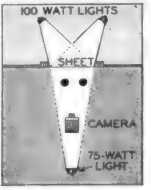


Figure 3

watt bulbs in reflectors will serve splendidly for the straight silhouette pictures. For special effects you will need somewhat stronger lights. Where you wish to line just the edge of objects or figures in the scene, place your lights as shown in Figure 2. Use the 200 watt light nearer to the subjects than the lights in back of the sheet. The effect shown in Figure 3 is obtained by using a weaker light in back and above the camera to faintly illuminate the shadow side. Be careful not to place this light too near the subjects or the silhouette effect will be destroyed.

Novel Stunts for Your Camera

BUILDING A HOUSE IN FOUR MINUTES

AN ENTERPRISING amateur recently showed pictures of his house being built, from the excavation to the completed job, and on the screen it needed only four minutes and ten seconds to do the work. Magic, you say? Not at all. You can do the same with your own camera. The first shot should be two or three feet of the land being broken for the excavation. A week later, the excavation is finished and another two or three feet of this is made. During the course of construction, a similar amount is shot of the more important stages of the work as it progresses. When the house is finished, the different shots are arranged in sequence after being cut out of the various 100 foot reels. These are then spliced and when the finished 100 foot reel is shown on the screen with appropriate titles your house will seem to rear itself as if by magic.

WATCHING YOUNGSTERS GROW

A DOCTOR movie enthusiast recently made movies of his youngster a few hours after it was born. Every six months thereafter he made 25 or 50 feet of film. Ten years from now this living record will be of inestimable value to him, for in a few moment's time he can see his child grow before his very eyes, and live over again the happy moments of past years. Still pictures and the old parlor album cannot begin to compare with this modern method of keeping fresh the memories of our loved ones.

Lon Chaney poses for a silhouette shot, made by the methods Mr. Kerst explains above. Photo by courtesy of Movie Makers magazine.

Leo, the lion trademark of Metro-Goldwyn-Mayer movies, makes a roaring debut in the talkies. The microphone and camera are shown all set to shoot Leo, but it was only after considerable tail-twisting that he consented to let forth a real lion-sized roar.

ANIMATED TRAVEL

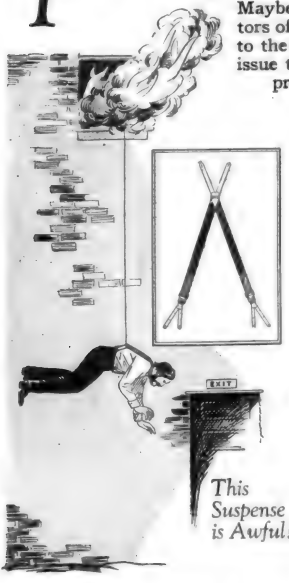
TRAVEL films can be "pepped" up by animating the scenes of places visited, showing the train, car or whatever mode of travel used, speeding over a map of the places visited. Make a simple black and white outline map of the desired town, city or country and then a separate black and white or half tone picture of the vehicle of travel, say a motor car. Set the map up the same as when photographing titles except that the map should be spread out on the floor or ground and the camera placed above it, fastened to some support so that the lens is parallel to the map, and shooting down vertically at it. Place the illustration of your motor car at the point where the pictures start the trip. Press the button lightly, exposing one or two frames of film. Move motor car a quarter of an inch or so, take a few more frames of film, and so on. When you reach a point on the map where you made a stop and filmed pictures, the name of the place can be made to appear suddenly by placing on the map the name printed on a separate slip of white paper, and shooting a few more frames. Many other ways of using this idea will suggest themselves as you progress. Indeed, it is possible to do away with the usual titles in many films by using this animated method of travel.

WORM'S EYE VIEW

NO DOUBT most of you have seen in your local movie theatre a scene of an approaching train, made from the level of the tracks on the ground. The train comes nearer and nearer and suddenly leaps right on out of the screen, apparently over the heads of the audience. Before the days of motor driven cameras, cameramen risked their lives to get such scenes. They had to burrow themselves between the tracks in a shallow trough, and keep cranking while the train thundered on above them. To make a similar shot today, all you have to do is to wind your camera, place it between the ties of the railroad track, tilting it upwards so that it will take in the proper angle of the approaching train. When the train is at the proper distance press the starting button and lock it in place, step aside, and the train rushes over the camera, which is clicking merrily secure in its place between the tracks. Numerous scenes can be made in this way, and the effects on the screen are thrilling.

PATENTS — NUTTY or NOVEL?

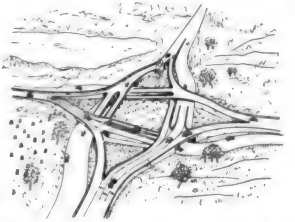
Maybe you don't believe that the inventors of the devices shown below ever went to the expense of having the government issue them patents, but they did—we can prove it by patent office records!



COLLAPSIBLE HEAD REST

ROCK a bye, Baby, sleep sitting up! George Pullman, were he living, would no doubt be interested in the possibilities of this invention. It is an early and authentic version of the original pogo stick. The user, riding trains, and being unable to obtain sleeping accommodations, merely unfolds the combined optician's headrest and seance stool, adjusts himself comfortably, and snores away lustily in the arms of Morpheus. The pogo stick today is a jumping stilt, with springs on. My! How times change!

MUSCULAR ROAD CROSSING



Three guesses what the above drawing is a picture of! You lose—it isn't a cross section of a human muscle; it's a bird's eye view of what a popular highway crossing will look like a few years hence. Automobiles, street cars, bicycles and kiddie cars all have their own lanes of travel, and the idea is that they won't bump into each other and there won't be any more highway accidents and everybody will get along swimmingly. Anyhow, we've got a hunch that this muscular road crossing might be a dizzy place for a big butter-and-egg man to wander into on his way home from a party.

ELASTIC GALLUSES ARE LIFE-SAVERS

THOSE of Modern Mechanics readers who have traveled about in country towns and who have slept in small hotels will be familiar with the merits of the above pair of suspenders. You probably have seen the little paper sacks placed near hotel windows wherein ropes are placed to enable the roomer to slide down outside in case of fire. This pair of suspenders is a condensed version of the hotel life-saving rope. The modus operandi is as follows: Presuming the wearer is asleep and an alarm is sounded, and presuming the wearer is sleeping in his clothes (not a bad idea in some hotels) the ends of the suspenders are hooked to a bed or other handy object and the leap for life is made. The elastic unravels and floats you to earth.

Boy's Cruiser, "Humpty-Dumpty," is Built V-Bottom

This wash drawing shows Humpty Dumpty under sail. Our artist, Mr. Worden Wood, being a "down easter" and knowing what boats look like, has visualized for Modern Mechanics navy of boating fans this great little toy cruiser. All the dimensions needed to enable anyone fairly familiar with boat building to build her, will be found in this article by Weston Farmer. Ballasted with concrete and fitted with an abbreviated bunk, this makes a fine little cruising vessel for boys around the average summer watering place.

After an afternoon of cement loading, Humpty Dumpty was ballasted, towed to midchannel and this shot was then taken.

The Genesis of "Humpty-Dumpty"

How to Build a Real Boy's Cruiser

by WESTON FARMER
Naval Architect

IT IS queer the way boats are born in the minds of men who design them. Take *Humpty Dumpty*, for instance.

This little tub was conceived as a result of the many questions I asked myself one August day as I lay confined on the underside of a red patchwork quilt in a cabin on the north shore of Lake Superior. The leisure enforced by an auto accident enabled me to study the plans of *Peggy*, which is the name of a little boat designed by one Sam Rabl, a naval architect who resides in Baltimore. Sam has as many original ideas on how boats should be built as a red-headed republican senator might have. I liked his design and wondered if I should ever be able to build one like her.

Among the unusual features of Sam's *Peggy* design, was the diagonal bottom planking, also the small size of the boat. And, too, the simplicity of her rig. The more I thought the better I liked her. So I planned, vaguely, a toy boat that could be built just as a pastime which would be smaller than *Peggy*, different than *Peggy*, but which would still have some of her originality.

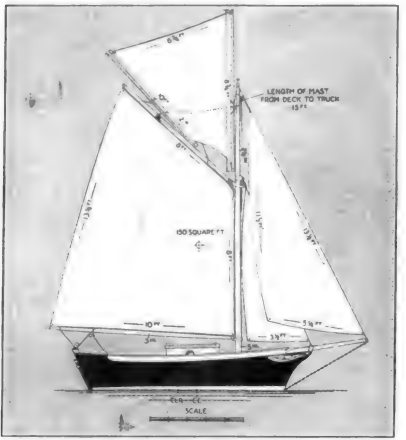
Then one day a generous editor sent a generous check for a story, and *Humpty Dumpty* came to life overnight. Her model was whittled out forthwith, the lines shown in the accompanying blueprint were taken from the model, and the order placed with a good boatbuilder.

As work progressed, day after day, photos were taken so that a complete visual history of the boat could be preserved and passed along to fellow boat bugs.

That, in short, is the story of how *Humpty Dumpty* came to be.

But wait till I tell you of her building, and how you might go about making one like her. Then I'll tell you a few things

She's Cutter Rigged—Like a Big 'Un



The sail plan is small and snug. Dimensions of the sail are given, and any sailmaker will be able to make the sails from this sail plan, and any boatbuilder will be able to rig the boat. The hull is blue, the bright work natural varnished.

about her and the way she acts.

From a perusal of her lines you will see that she is a V-bottomed boat. The cross sections appear as vees, rather than as round and curved.

This, you will observe, makes for extreme simplicity of building, as there are no curved frames to build or plank around. The construction of *Humpty Dumpty* is about as complicated as the construction of a soap box. Of course, it is not presumed that one unfamiliar with boatbuilding will attempt to build her. But any man who understands boats, or any boatbuilder, will be enabled to help you produce a very satisfactory boat from the plans herewith. Right at the outset I caution you to secure the help of a man who knows boats if you would build her—and this holds true of any boat plan, no matter how simple. If the reader is not a boatman help should be procured in building.

The frames are made the first of all. The lines are laid down in full size as taken from the lines drawing in the blueprint. Make not only a half breadth plan full size, and also a profile plan, but see that they check with each other by taking off the heights at the keel, at the chine and the deck line at each station and setting them at their proper distance from the center line by measuring off the half breadths.

When you have finished with the laying down of the full size lines, you will have a cross section drawing like figure 6, which you can make the mold frames from. These look like the frames shown in fig. 1. They are ¾-ins. by 5-ins., of spruce, and are tied with floors across the bottom where they rest on the keel as shown in the photo.

They are fastened together at the chine with brass screws and a notch is cut for the inside chine.

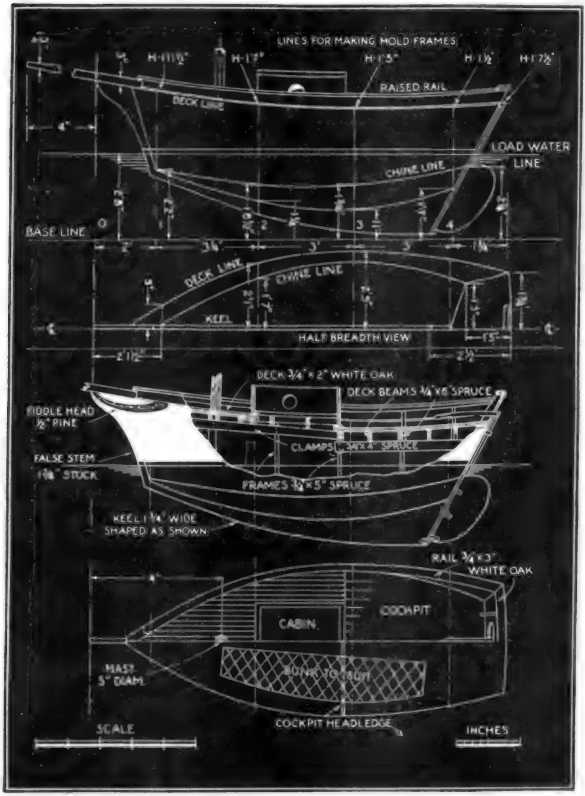
The frames are all lined up in the 1¾ inch white oak keel which is cut from 2x12 stock and which is scarphed as the side art in figure 2 indicates.

The frames are fastened to the keel by a bolt which runs through the edge grain of the floors and through the keel. These bolts are made with a thread cutter and a length of galvanized iron rod, ¼-inch in diameter. The threads are cut after the proper length for the bolt has been determined and the ends have been hacked to size.

Use plenty of white lead in setting down the washer and the bolt. It will preserve the wood and help make the boat tighter.

The rabbet, or that part of the keel which is usually chiseled out to allow the garboard or nearest-keel plank to be fastened, is dispensed with a la Sam Rabl in this design. Instead of laboriously chiseling out the groove in the keel, Rabl and others of

Lines, Construction Plan, and All Measurements



Shown to scale here are the complete details, with measurements, for the building of Humpty Dumpty. The figures H-1' 1½ at the top of the deck line mean the height of the deck line above waterline. Other dimensions indicated by dimension lines. The construction plan is given as an example and a guide rather than a design to be followed to the letter.

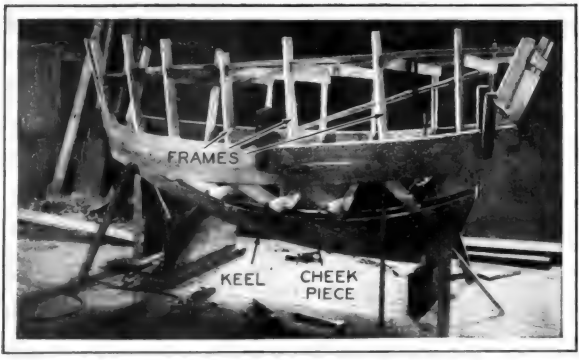
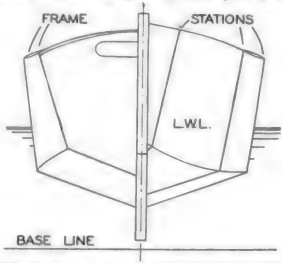


Fig. 1. The keel, the stem and the frame for the transom are set up on the shop floor. Then the mold frames are put in and tied with cross braces. The planking is then put around the topsides, from the chine up as shown.

the Chesapeake boatbuilding regions fasten a beveled piece of wood, called a cheek piece, to the side of the keel. This is fastened with brass screws spaced about 2½-inch intervals and slightly staggered in the 1½ by 1½ white oak cheek piece. The cross section drawing will show how it is beveled.

One of the beauties of the Chesapeake bay type of construction, along which lines *Humpty Dumpty* is designed, is that absolutely no false work needs to be made. There are no molds to be made, or rib-bands, or the usual "fruit" of boatbuilding. The frames you take from the body plan are the frames which not only mold the shape of the boat, but they stay there permanently. For that reason I have taken a little liberty with the usual boatbuilding terms and have called them mold-frames, since they serve the purpose of both.

Another good feature of the Chesapeake type of construction is that there are no battens used behind the seams, as is the case in some kinds of V-bottom construction. The seams when done have a piece run from the chine to the sheer plank to keep the planks between frames from shifting and weaving. These pieces may be any size or weight of wood, but need be no larger than the size needed to hold the brass ¾-inch screws with which the ⅝-inch planking is fastened. On the frames, 1¼ screws are used. Brass is the only thing to use in a boat like this because the cypress planking will be very apt to split if nails are used. The common wire or carpenter nails should be left out of the construction entirely. A letter to E. J. Willis & Co., 85 Chamber St., N. Y. City, mentioning this article, will bring you information, on the hardware for *Humpty Dumpty*, and this firm will be glad to mail you their



This is the body plan of the boat from which the frames are made. As the story shows, the cross section lines must be laid down full size and the frames then made from the patterns thus obtained.

catalogue in addition to making recommendations.

That, in substance, is an outline of the procedure through which you must go in chronological order to get the boat built. If you will follow the photographs on the method of building, over to the left you will see the boat set up. The keel, fig. 1, has been cut to the shape shown in the lines drawing on the blueprint. The keel has been set up and braced. The transom framing also has been placed. It is built out of $\frac{5}{8}$-inch thick cypress planking set over a frame of spruce $\frac{3}{4}$ by 5 inches in much the same manner as shown in the top view of the boat. This view shows the transom framing clearly. Should you desire more information on the subject, the Motor Boat Handbook, Vol. III, can be had from Chas. Hall, 101 West 31st St., N. Y. City, for the sum of one dollar. Within the scope of this article there is not enough space to discourse on the general manner of framing transoms, and for that reason, anticipating some readers will want to know more than we have space for elucidating herewith, we make the above suggestion.

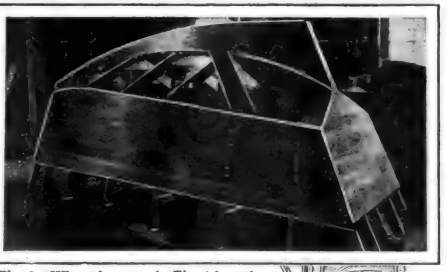
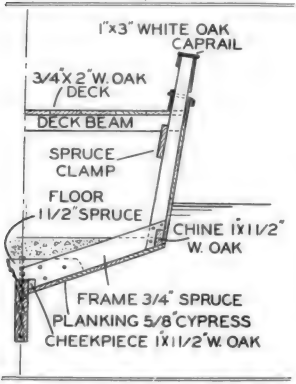


Fig. 2. When the steps in Fig. 1 have been done, the boat is turned turtle on the floor, and the diagonal bottom planking put on as this view shows. Note the brass screw fastenings.



Here are all the cross sectional details for Humpty. Note the manner in which the chine piece and the cheek pieces are placed. The bottom planking is shown as having been sliced diagonally. Cement is poured into the hull against the bare wood when the hull has been launched.

When, as in fig. 1, the frames have been erected and the transom also, the chine pieces and the cheek pieces, dimensions for which will be found in the cross section drawing are fastened in place. Then starting with the plank nearest the chine—the chine is the boatbuilding term for the sharp corner in the frame—it is planked on. First one side is fastened and then the other. It will be necessary to use two lengths for all these planks, and they are joined by carefully cutting them off flush so that they butt against each other at the ends, and by fastening them with a butt block inside the boat, secured with brass screws.

The seams are beveled a bit—left flush on the inside edge and about a sixteenth of an inch open on the outside. This is for the caulking cotton to be driven into. Any boat must be caulked when there are no seam battens behind the seam. The seam is finished off with white lead and scraped even with the hull with a putty knife.

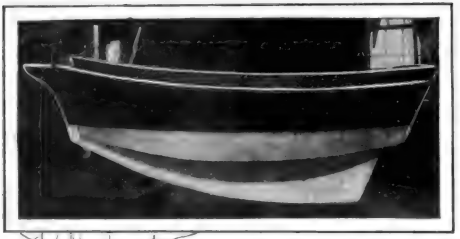


Fig. 5. The completed hull ready to launch. Painted, sanded, with hardware installed, and ready for the "drink."

When the top sides have been planked, the boat is turned bottom up and the diagonal bottom planking is put on as in figure 2, running at an angle of about 45 degrees from the keel with the outside edge farthest aft. This allows the bottom plank to be fastened to the cheek piece, to two frames, and to the chine piece. Thus the bottom planks when once put on are there to stay.

Fig. 4. The deck framing. No set plan need be followed, but the one used by the designer is clearly shown in this view. A covering board is worked around the frames, and the white oak decks laid.

The outside of the hull then can be primed with a coat of white lead paint, mixed thin. Use half turpentine and half paint and prime with two coats, sanding lightly between each coat to take off the raised whiskers which the first coat will leave. Be sure the first coat of paint is dry before you apply the second one.

The decks are then laid. Some mention of this procedure has already been made. The deck beams are of spruce and are laid in substantially the manner shown in the top view of the boat. There is no special planning of the way the beams are laid. They are there to support the decking and as long as they fulfill that function there will be no complaint in the service the decks can give. Note that there are three beams in the way of the mast. This makes for rigidity. The mast is mounted, not through the deck and heeled inside the boat, but the heel is allowed to rest right on the deck over the three deck beams, which are of the same scantling measurement as the rest of the deck beams.

The mast is fastened with a long lag screw.

The rail and the bulwarks, or raised rail as the drawing made from my plans by Modern Mechanics staff artists calls it, will need a word or two of explanation.

From the cross sectional view which shows how the frames are made, how thick the planking, chine and cheek pieces are, you will observe that the ends of the frames are allowed to pass the deck line. Between them, as you will observe from the top view or deck view of the boat, the covering board or planksheer, as it is sometimes called, is fitted. When the plank sheer is fitted, the boat can be decked, the ends of the decking butting up tangent to the covering board. This will leave the ends of the frame protruding from the hull of the boat. Six inches from the deck in the front end of the boat tack a batten. Then

parallel to the deck line, or sheer line as boatbuilders call it, tack the batten back around the rest of the frames. Mark each frame, and saw off square. Then place the 5/8 cypress raised rail about them, fastening as usual with brass screws. Leave a little waterway of, say, 1/2 inch or so, between the deck and the raised rail.

After the raised rail has been fastened and allowed to run past the transom, it is sawed off flush with that worthy member, and the edge of the rail planed flush with the heads of all of the clipped frames. Then the 1 x 3-inch white oak rail is screwed down to the heads of the frames and to the raised rail. The inside of the cockpit is lined between the deck line and the sunken floor line with light spruce or cypress. This portion of the work cannot be well explained by drawings, but it will show up when the work has progressed far enough along to have reached this stage.

The decks are finished by scraping them after they have been planed. They are fastened, of course, with screws, and the screws are countersunk deeply, in holes which have been cut with a Forstner bit so that wood plugs can be put over the screw heads and be glued in. The plugs are cut flush with the deck with a chisel, and the planing and scraping processes are completed. The bright work of the ship is varnished three coats of varnish, with sanding and thorough drying between each coat. It is possible to oil the decks with linseed oil as the original *Humpty* had, but the oil will cook out in the sunlight and the decks without the varnish will really weather too fast.

The topsides are painted with a blue such as is shown in the wash drawing which Worden Wood did to illustrate this article. There being no pictures available of the boat under sail with her full rig on, the artist was called upon to interpret the architect's conception of the little vessel under sail.

It is hard for many to believe that *Humpty Dumpty* carries about 1,200 lbs. of concrete in her little innards to set her down on the water to the line indicated in the drawing. Yet Ole Hanson, and John Redeen, of the splendid boatbuilding firm of Wayzata Boatbuilding Company, Wayzata, Minn., worked all afternoon mixing cement aggregate and pouring it into the little wagon. Pail after pail they handed to me as I stood barefoot in the hatch pouring the warm, slushy stuff into her bilge, smoothing it level with a stick.

All this weight is to make a safe boat of *Humpty*, and a good sailer. If she didn't set down to the designed water line, the winds would have her at their mercy, for light she is a tender form of hull. Laden with ballast she is as solid as the average thirty-footer, and the winds carry her along in great style.

That is about all that I can say regarding the building of *Humpty Dumpty*. To explain how every screw is placed would be useless. The main steps in building the little packet have been outlined, and that, the writer thinks, is enough for any handy boat bug. Directions will always furnish themselves on any sort of building project —and, well, if a point or two is not clear, the editor is always glad to answer questions.

Fig. 3. When the steps in Fig. 1 and Fig. 2 have been completed, the plank fastenings are countersunk, the planking planed, the boat righted, sanded and primed with lead paint.

LOST *Inside the* EARTH

by EDGAR RICE BURROUGHS, *Author of "Tarzan"*

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Don't miss the concluding chapters in this great story of strange adventure at the core of the earth, appearing below. It is one of the best stories Mr. Burroughs has written. A summary of previous chapters is printed as part of the story.

WHEN Perry invented his underground prospecting machine, I had no idea that it was destined to carry the two of us to the very center of the earth—but that, incredibly, is just what happened! I had been furnishing Perry with money to finance his invention, and when he completed the man-carrying drill we both stepped inside its chamber, turned on the power, and began boring beneath a mountain in search of gold bearing ore.

The Prospector, as we called the machine, was a jointed metal tube with huge drills in its nose which bored through the earth at several miles an hour. After we had gone a short distance we were ready to return to the earth's surface, but when we tried to turn the steering wheel we found it jammed—we were helpless, boring straight down to the center of the earth!

After several hours we were almost suffocated from lack of fresh air in our cramped chamber, and we both lost consciousness. When we recovered the Prospector had stopped, and when we opened the door we found ourselves in a strange world at the very core of the earth. Venturing after food, we were captured by a race of ape-men and taken to the city of the Mahars, hideous reptiles which were the ruling creatures of this queer country. A beautiful young woman, Dian by name, was also a captive, but she escaped before we reached the city of Phutra.

I, too, escaped after a time, but Perry was not with me and I felt in honor bound to return to him. When I reappeared in the Mahar city, explaining that I had returned voluntarily, I was sentenced to the horrible chambers where the Mahars practiced vivisection on human beings.

I WALKED in silence beside my guard down through dark corridors and runways toward my awful doom. At a low level we came upon a number of lighted chambers in which we saw many Mahars engaged in various occupations. To one of these chambers my guard escorted me, and before leaving they chained me to a side wall. There were other humans similarly chained. Upon a long table lay a victim even as I was ushered into the room. Several Mahars stood about the poor creature holding him down so that he could not move. Another, grasping a sharp knife with her three-toed fore foot, was laying open the victim's chest and abdomen. No anesthetic had been administered and the shrieks and groans of the tortured man were terrible to hear. This, indeed, was vivisection with a vengeance.

The Mahars had paid not the slightest attention to me as I had been brought into the room. So deeply immersed were they in their work that I am sure they did not even know that the Sagoths had entered with me. Upon the floor between me and the Mahars lay a tiny surgical instrument which one of them must have dropped. It looked not unlike a buttonhook, but was much smaller, and its point was sharpened. A hundred times in my boyhood days had I picked locks with a buttonhook.

Crawling to the limit of my chain, I found that by reaching one hand as far out as I could my fingers still fell an inch short of the coveted instrument.

At last I turned about and extended one foot toward the object. My toes dropped upon the cold metal. Gradually I worked it toward me until I felt that it was within reach of my hand and a moment later I had turned about and the precious thing was in my grasp.

Assiduously I fell to work upon the Mahar lock that held my chain. It was

As before on that far-gone night that had witnessed our first trial of the iron monster, there was a frightful roaring beneath us—the giant frame trembled and vibrated—there was a rush of sound, and we were off!

pitifully simple. A child might have picked it, and a moment later I was free.

The Mahars at the table had their backs toward me. I gave two mighty leaps that carried me out of the chamber into the corridor beyond, down which I raced with all the speed I could command. Presently I reduced my speed to a brisk walk. After a time I came to a passage that seemed in some mysterious way familiar to me, and presently, chancing to glance within a chamber which led from the corridor I saw three Mahars curled up in slumber upon a bed of skins. It was the same corridor and the same Mahars that I had intended to have lead so important a role in our escape from Phutra.

My one great danger now lay in returning to the upper levels in search of Perry and Ghak, but there was nothing else to be done, and so I hastened upward. I found Perry and Ghak together in the chamber where we had been wont to eat and sleep.

Both were glad to see me, it is needless to say, though of course they had known nothing of the fate that had been meted out to me by my judges. It was decided that no time should now be lost before attempting to put our plan of escape to the test.

Down to the main floor we encountered many Mahars, Sagoths, and slaves; but no attention was paid to us as we had become a part of the domestic life of the building. Wrapped in a skin I carried three swords, and the two bows, and the arrows which Perry and I had fashioned. Where I left Ghak and Perry there were no other creatures in sight, and so I withdrew one sword from the package, and leaving the balance of the weapons with Perry, started on alone toward the lower levels.

Having come to the apartment in which the three Mahars slept I entered silently on tiptoe, forgetting that the creatures were without the sense of hearing. With a quick thrust through the heart I disposed of the first but my second thrust was not so fortunate, so that before I could kill the next of my victims it had hurled itself against the third, who sprang quickly up, facing me with wide-distended jaws. It made a

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dash to escape me. But I was too quick for it, and so, half hopping, half flying, it scurried down another corridor with me close upon its heels.

Of a sudden it turned into an apartment on the right of the corridor, and an instant later as I rushed in I found myself facing two of the Mahars. The one who had been there when we entered had been occupied with a number of metal vessels, into which had been put powders and liquids. In an instant I realized what I had stumbled upon. It was the buried chamber in which was hidden the Great Secret of the race of Mahars. And on the bench beside the flasks lay the skin-bound book which held the only copy of the thing I was to have sought, after dispatching the three Mahars in their sleep.

There was no exit from the room other than the doorway in which I now stood facing the two frightful reptiles. Together they launched themselves upon me, and though I ran one of them through the heart on the instant, the other fastened its gleaming fangs about my sword arm above the elbow.

With what seemed to me my last ounce of strength I ran the blade through the ugly body of my foe.

It was with an emotion of triumphant pride that I stepped across the convulsively stiffening corpse to snatch up the most potent secret of a world. A single glance assured me it was the very thing that Perry had described to me.

I tucked the book in the thong that supported my loin cloth, and turned to leave the apartment. At the bottom of the corridor which leads aloft from the lower chambers I whistled in accordance with the prearranged signal which was to announce to Perry and Ghak that I had been successful. A moment later they stood beside me, and to my surprise I saw that Hooja the Sly One accompanied them.

I had no love for Hooja, and no confidence in him. I was sure that if he thought it would profit him he would betray us; but I saw no way out of it now.

Some time later we had removed the skins from the four Mahars, and so succeeded in crawling inside of them ourselves that there seemed an excellent chance for us to pass unnoticed from Phutra.

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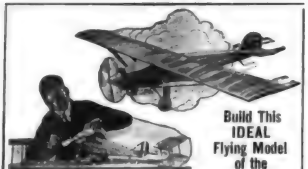

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INSIDE THE EARTH

Thus we started up toward the main floor of the building. Ghak headed the strange procession, then came Perry, followed by Hooja, while I brought up the rear.

Slowly, after the manner of locomotion habitual to the Mahars, when they are not using their wings, we crept through throngs of busy slaves, Sagoths, and Mahars. After what seemed an eternity we reached the outer door which leads into the main avenue of Phutra.

On we went up the broad street, but now we were safe for the very numbers of our enemies that surrounded us on all sides. In the thick of the crowd we passed up the steps of Phutra and out onto the plain.

The heat of the vertical rays of the sun was fast making our horrible prisons unbearable, so that after passing a low divide, and entering a sheltering forest, we finally discarded the Mahar skins that had brought us thus far in safety.

On and on we raced, our one thought to put as much distance between ourselves and Phutra as possible. Ghak was leading us to his own land—the land of Sari.

At last, after what seemed months, and may, I now realize, have been years, we came in sight of the dun escarpment which buttressed the foothills of Sari. At almost the same instant, Hooja, who looked ever quite as much behind as before, announced that he could see a body of men far behind us topping a low ridge in our wake. It was the long-expected pursuit.

A backward glance gave me a glimpse of the first of the Sagoths at the far end of a considerable straight stretch of canon through which we had just passed, and then a sudden turning shut the ugly creature from my view.

Again the canon veered sharply to the left, but to the right another branch ran on at a lesser deviation from the general direction, so that it appeared more like the main canon than the left-hand branch.

Pausing at the junction I waited until the foremost Sagoth hove into sight. Ghak and Perry had disappeared around a bend in the left-hand canon, and as the Sagoth's savage yell announced that he had seen me I turned and fled up the right-hand branch.

A few yards beyond the canon's end, the path widened, and at my left I saw the opening to a large cave. Before, the ledge

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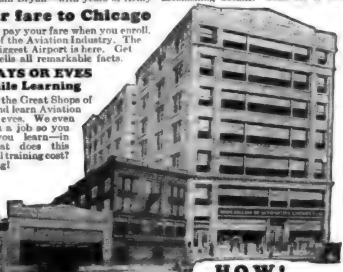

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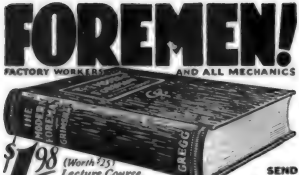

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INSIDE THE EARTH

continued until it passed from sight about another projecting buttress of the mountain.

Here, I felt, I could defy an army, for but a single foeman could advance upon me at a time, nor could he know that I was awaiting him until he came full upon me around the corner of the turn. As I stood there, tense and silent, listening for the first faint sound that should announce the approach of my enemies, a slight noise from within the cave's black depths attracted my attention.

And then from the inky blackness at my right I saw two flaming eyes glaring into mine.

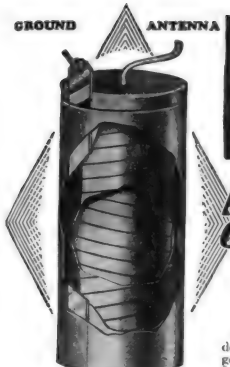
Whatever it was, the animal was coming slowly toward the entrance of the cave, and now, deep and forbidding, it uttered a low and ominous growl. I waited no longer to dispute possession of the ledge with the thing which owned that voice.

As I backed along the ledge I soon was past the mouth of the cave, where I no longer could see those fearful flaming eyes, but an instant later I caught sight of the fiendish face of a Sagoth as it was warily advancing beyond the cliff's turn on the far side of the cave's mouth. At the same time the beast emerged from the cave, so that he and the Sagoths came face to face upon that narrow ledge.

The thing was an enormous cave bear, rearing its colossal bulk fully eight feet at the shoulder. As it sighted the Sagoths it emitted a most frightful roar, and with open mouth charged full upon them.

Shrieking Sagoths were now leaping madly over the precipice to escape the bear, and the last I saw he rounded the turn still pursuing the demoralized remnant of the man hunters. Not caring to venture back into the canon, where I might fall prey either to the cave bear or the Sagoths I continued on along the ledge, believing that by following around the mountain I could reach the land of Sari from another direction.

With no heavenly guide, it is little wonder that I became confused and lost in the labyrinthine maze of those mighty hills. I know that I wandered for a long time, until tired and hungry I came upon a small cave in the face of the limestone formation which had taken the place of the granite farther back.



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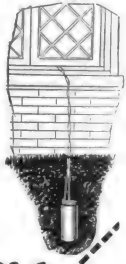

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INSIDE THE EARTH

I determined to make the cave my headquarters, and with it as a base make a systematic exploration of the surrounding country in search of the land of Sari. Then I hid the Great Secret in a deep niche at the back of my cave, rolled a bowlder before my front door, and with bow, arrows, sword, and shield scrambled down into the peaceful valley.

At the valley's end the cliffs upon the left run out into the sea, so that to pass around them as I desired to do it was necessary to scale them in search of a ledge along which I might continue my journey. Some fifty feet from the base I came upon a projection which formed a natural path along the face of the cliff, and this I followed out over the sea toward the cliff's end.

Here the ledge inclined rapidly upward toward the top of the cliffs. As I climbed carefully up the ascent my attention suddenly was attracted aloft by the sound of strange hissing, and what resembled the flapping of wings.

And at the first glance there broke upon my horrified vision the most frightful thing I had seen even within Pellucidar. It was a giant dragon such as is pictured in the legends and fairy tales of earth folk. Its huge body must have measured forty feet in length, while the batlike wings that supported it in midair had a spread of fully thirty.

The hissing noise which had first attracted my attention was issuing from its throat, and seemed to be directed at something beyond and below me which I could not see. The ledge upon which I stood terminated abruptly a few paces further on, and as I reached the end I saw the cause of the reptile's agitation.

Some time in past ages an earthquake had produced a fault at this point, so that beyond the spot where I stood the strata had slipped down a matter of twenty feet. The result was that the continuation of my ledge lay twenty feet below me, where it ended as abruptly as did the end upon which I stood.

And here, evidently halted in flight by this insurmountable break in the ledge, stood the object of the creature's attack—a girl cowering upon the narrow platform, which hovered just above her.

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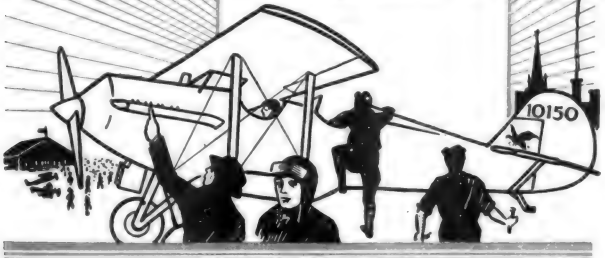

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INSIDE THE EARTH

Almost thoughtless of the consequences, I leaped from the end of the ledge upon which I stood, for the tiny shelf twenty feet below.

The noise I made as I landed beside her convinced the girl that her end had come, for she thought that I was the dragon; but finally when no cruel fangs closed upon her she raised her eyes in astonishment.

"Dian!" I cried. "Dian! Thank God that I came in time."

"You?" she whispered, and then she hid her face again; nor could I tell whether she were glad or angry that I had come.

Once more the dragon was sweeping toward us, and so rapidly that I had no time to unsling my bow. All that I could do was to snatch up a rock, and hurl it at the thing's hideous face. My aim was true, and with a hiss of pain and rage the reptile wheeled once more and soared away.

I selected my longest arrow, and with all my strength had bent the bow until the very tip of the shaft rested upon the thumb of my left hand, and then as the great creature darted toward us I let drive straight for that tough breast.

Hissing like the escape valve of a steam engine, the mighty creature fell turning and twisting into the sea below, my arrow buried completely in its carcass. I turned toward the girl. She was looking past me.

"Dian," I said, "won't you tell me that you are not sorry that I have found you?"

"I hate you," was her only reply; but I imagined that there was less vehemence in it than before—yet it might have been but my imagination.

"What are you doing here?" I asked, "and what has happened to you since Hooja freed you from the Sagoths?"

"I was again running away from Jubal the Ugly One," she said. "He has been pursuing me across many lands. He cannot be far behind me now. When he comes he will kill you and carry me back to his cave.

"But he shall not have me," she suddenly cried, with great vehemence. "The sea is there"—she pointed over the edge of the cliff—"and the sea shall have me rather than Jubal."

"But I have you now, Dian," I cried: "nor shall Jubal, nor any other have you,

for you are mine," and I seized her hand, nor did I lift it above her head and let it fall in token of release.

She had risen to her feet, and was looking straight into my eyes with level gaze.

"If you mean all that you say you will have ample chance to prove it," she said, "if Jubal does not catch and kill you."

I led Dian back along the ledge the way she had come, searching for a path that would lead us to the top of the cliff, for I knew that we could then cross over to the edge of my own little valley, where I felt certain we should find a means of ingress from the cliff top.

Presently we found a rift in the cliff which had been widened and extended by the action of water draining through it from the plateau above. It gave us a rather rough climb to the summit, but finally we stood upon the level mesa which stretched back for several miles to the main mountain range.

At our right lay a dense forest, but to the left the country was open and clear to the plateau's farther verge. It was in this direction that our way led, and we had turned to resume our journey when Dian touched my arm.

"Jubal," she said, and nodded toward the forest.

I looked, and there, emerging from the dense wood, came a perfect whale of a man. He must have been seven feet tall, and proportioned accordingly.

"Run," I said to Dian. "I can engage him until you get a good start. Maybe I can hold him until you have gotten entirely away," and then, without a backward glance, I advanced to meet the Ugly One.

When I had come close enough to Jubal to distinguish his features I understood how it was that he had earned the sobriquet of Ugly One. Apparently some fearful beast had ripped away one entire side of his face. The eye was gone, the nose, and all the flesh, so that his jaws and all his teeth were exposed and grinning through the horrible scar.

He had broken into a run now, and as he advanced he raised his mighty spear, while I halted and fitting an arrow to my bow took as steady aim as I could. And then the great brute launched his massive stone-tipped spear, and I raised my shield

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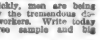

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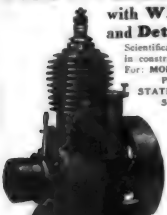

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INSIDE THE EARTH

to break the force of its terrific velocity. The impact hurled me to my knees, but the shield had reflected the missile and I was unscathed. Jubal was rushing upon me now with the only remaining weapon that he carried—a murderous-looking knife. He was too close for a careful bowshot, but I let drive at him as he came, without taking aim. My arrow pierced the fleshy part of his thigh, inflicting a painful but not disabling wound. And then he was upon me.

It was a duel of strategy now—the great, hairy man maneuvering to get inside my guard where he could bring those giant thews to play, while my wits were directed to the task of keeping him at arm's length. Thrice he rushed me, and thrice I caught his knife blow upon my shield. Each time my sword found his body—once penetrating to his lung.

His next act was a sort of forlorn hope, which could only have been born of the belief that if he did not kill me quickly I should kill him. Seizing my sword blade in both his hands he wrenched the weapon from my grasp as easily as from a babe.

As he came for me, like a great bear, I ducked again beneath his outstanding arm, and as I came up planted as clean a blow upon his jaw as ever you have seen. Down went that great mountain of flesh sprawling upon the ground. Up he came at last, almost roaring in his rage and mortification.

He was bleeding very profusely now from the wound in his lungs, and presently a terrific blow over the heart sent him reeling heavily to the ground, where he lay very still, and somehow I knew at once that Jubal the Ugly One would never get up again.

I turned to gather up my shield and bow to hurry after Dian, when to my astonishment I found her standing not ten paces behind me.

"Girl!" I cried, "what are you doing here? I thought that you had gone to the cave, as I told you to do."

"As you told me to do!" she cried, stamping her little foot. "I do as I please. I am the daughter of a king, and, furthermore, I hate you."

I was dumbfounded—this was my thanks

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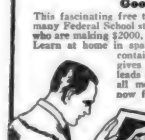

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INSIDE THE EARTH

for saving her from Jubal!

"Let us go to my cave," I said, "I am tired and hungry."

We had no difficulty in finding my lair, and then I went down into the valley and bowled over a small antelope, which I dragged up the steep ascent to the ledge before the door. Here we ate in silence.

"As you dare not return to Amoc," I ventured, "what is to become of you, since you cannot be happy here with me, hating me as you do?"

"I shall have to put up with you," she replied coldly, "until you see fit to go elsewhere and leave me in peace, then I shall get along very well alone."

I looked at her in utter amazement. It seemed incredible that even a prehistoric woman could be so cold and heartless and ungrateful. Then I arose.

"I shall leave you *now*," I said haughtily, "I have had quite enough of your ingratitude and your insults," and then I turned and strode majestically down toward the valley. I had taken a hundred steps in absolute silence, and then Dian spoke.

"I hate you!" she shouted, and her voice broke—in rage, I thought.

I was absolutely miserable, but I hadn't gone far when I began to realize that I couldn't leave her alone there without protection, to hunt her own food amid the dangers of that savage world.

I turned right around and went up that cliff again twice as fast as I had come down. I saw that Dian had left the ledge and gone within the cave, but I bolted right in after her. She was lying upon her face on the pile of grasses I had gathered for her bed. When she heard me enter she sprang to her feet like a tigress.

"I hate you!" she cried.

I never said a word to her at first. I just strode across the cave and grasped her by the wrists, and when she struggled. I put my arm around her so as to pinion her hands to her sides.

"Dian," I cried, shaking her roughly. "I love you. Can't you understand that I love you? That I love you better than all else in this world or my own? That I am going to have you? That love like mine cannot be denied?"

I noticed that she lay very still in my arms now, and as my eyes became accus-

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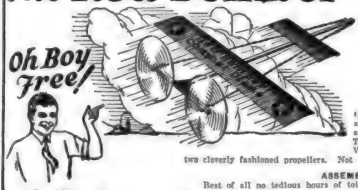
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INSIDE THE EARTH

tomed to the light I saw that she was smiling—a very contented, happy smile. I was thunderstruck. At last she spoke.

"Why didn't you do this at first, David? I have been waiting so long."

"What!" I cried. "You said that you hated me!"

"Did you expect me to run into your arms, and say that I loved you before I knew that you loved me?" she asked.

"Then you haven't hated me at all, Dian?" I asked.

"I have loved you always," she whispered, "from the first moment that I saw you, although I did not know it until that time you struck down Hooja the Sly One, and then spurned me."

"But I didn't spurn you, dear," I cried. "I didn't know your ways—I doubt if I do now. It seems incredible that you could have reviled me so, and yet have cared for me all the time."

"You might have known," she said, "when I did not run away from you that it was not hate which chained me to you."

"You little sinner!" I exclaimed. "And you have caused me all this anguish for nothing!"

After a time we decided to set out for Sari, as I was anxious to see Perry, and to know that all was right with him. I had told Dian about our plan of emancipating the human race of Pellucidar, and she was fairly wild over it.

We set out for the land of the Sarians, and it was with feelings of sincere regret that we bade good-bye to our beautiful Garden of Eden, in the comparative peace and harmony of which we had lived the happiest moments of our lives.

After a journey which was, for Pellucidar, quite uneventful, we came to the first of the Sarian villages which consists of between one and two hundred artificial caves cut into the face of a great chalk cliff. Here to our immense delight, we found both Perry and Ghak. The old man was quite overcome at sight of me for he had long since given me up as dead.

When I introduced Dian as my wife he didn't quite know what to say, but he afterward remarked that with the pick of two worlds I could not have done better.

At a council of the head men of the various tribes of the Sari the form of gov-

ernment for the federation of the human races was tentatively agreed upon. Roughly, the various kingdoms were to remain virtually independent, but there was to be one great overlord, or emperor. It was decided that I should be the first of the dynasty of the emperors of Pellucidar.

We set about teaching the women how to make bows and arrows, and poison pouches. The young men hunted the vipers which provided the virus, and it was they who mined the iron ore, and fashioned the swords under Perry's direction.

We sent our young men out as instructors to every nation of the federation, and the movement had reached colossal proportions before the Mahars discovered it. The first intimation they had was when three of their great slave caravans were annihilated in rapid succession.

In one of the skirmishes with slave caravans some of our Sarians took a number of Sagoth prisoners, and among them were two who had been members of the guards within the building where we had been confined at Phutra. They told us that the Mahars were frantic with rage when they discovered what had taken place in the cellars of the building.

Perry's experiments in the manufacture of gunpowder and the fashioning of rifles had not progressed as rapidly as we had hoped.

"David," said Perry, immediately after his latest failure to produce gunpowder that would even burn, "one of us must return to the outer world and bring back the information we lack. Here we have all the labor and materials for reproducing anything that ever has been produced above —what we lack is knowledge."

And so it was decided that I should return in the prospector, which still lay upon the edge of the forest at the point where we had first penetrated to the surface of the inner world. Dian would not listen to any arrangement for my going which did not include her, and I was not sorry that she wished to accompany me, for I wanted her to see my world, and I wanted my world to see her.

With a large force of men we marched to the great iron mole, which Perry soon had hoisted into position with its nose pointed back toward the outer crust. He went over all the machinery carefully. He replenished the air tanks, and manufactured oil

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for the engine.

There were a number of Mahar prisoners present at the ceremonies, and so fearful were our own people of them that they would not approach them unless completely covered from the sight of the reptiles by a piece of skin. Even Dian shared the popular superstition regarding the evil effects of exposure to the eyes of angry Mahars, and though I laughed at her fears I was willing enough to humor them if it would relieve her apprehension in any degree, and so she sat apart from the prospector, near which the Mahars had been chained, while Perry and I again inspected every portion of the mechanism.

At last I took my place in the driving seat, and called to one of the men without to fetch Dian. It happened that Hooja stood quite close to the doorway of the prospector, so that it was he who, without my knowledge, went to bring her; but how he succeeded in accomplishing the fiendish thing he did, I cannot guess, unless there were others in the plot to aid him.

All I know is that it was Hooja who brought Dian to the prospector, still wrapped from head to toe in the skin of an enormous cave lion which had covered her since the Mahar prisoners had been brought into camp. He deposited his burden in the seat beside me. I closed and barred the outer and inner doors, took my seat again at the driving mechanism, and pulled the starting lever.

As before on that far-gone night that had witnessed our first trial of the iron monster, there was a frightful roaring beneath us—the giant frame trembled and vibrated—there was a rush of sound as the loose earth passed up through the hollow space between the inner and outer jackets to be deposited in our wake. Once more the thing was off.

But on the instant of departure I was nearly thrown from my seat by the sudden lurching of the prospector. At first I did not realize what had happened, but presently it dawned upon me that just before entering the crust the towering body had fallen through its supporting scaffolding, and that instead of entering the ground vertically we were plunging into it at a different angle. Where it would bring us out upon the upper crust I could not even

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conjecture. And then I turned to note the effect of this strange experience upon Dian. She still sat shrouded in the great skin.

"Come, come," I cried, laughing, "come out of your shell. No Mahar eyes can reach you here," and I leaned over and snatched the lion skin from her. And then I shrank back upon my seat in utter horror.

The thing beneath the skin was not Dian—it was a hideous Mahar. Frantically I tore at the steering wheel in an effort to turn the prospector back toward Pellucidar; but, as on that other occasion, I could not budge the thing a hair.

It is needless to recount the horrors or the monotony of that journey. It varied but little from the former one which had brought us from the outer to the inner world. Because of the angle at which we had entered the ground the trip required nearly a day longer, and brought me out here upon the sands of the Sahara instead of in the United States as I had hoped.

That I ever shall see Dian again seems but remotely possible, for how may I know upon what part of Pellucidar my return journey may terminate—and how, without a north or a south or an east or a west may I hope ever to find my way across that vast world to the tiny spot where my lost love lies grieving for me?

The End.

DID DAVID INNES ever return to the lost world at the heart of the earth? Did he find his beloved Dian the Beautiful awaiting him there? These questions are inevitably asked by the readers of Edgar Rice Burroughs' "Lost Inside the Earth," and are fascinatingly answered in the author's novel, "Pellucidar." Returning to the earth's core in the Prospector, David finds his old friend Perry, and they organize the human races into a compact army possessing gunpowder, cannons, and rifles. Dian, who has been held captive by the treacherous Hooja, is rescued by David, who leads his conquering armies on until the reptile rulers of the buried world are exterminated. The tale of how David and Dian and Perry teach the human races to get along peacefully with one another, to build great industrial cities, to study agriculture, makes a fascinating story.

CARTER OF THE RED PLANET

(Continued from page 125)

soon became evident that she would strike the face of the buildings about a mile south of our position.

The Prisoner of the Air

AS THE craft neared the building, and just before she struck, the Martian warriors swarmed upon her from the windows.

After making her fast, they swarmed the sides and searched the vessel from stem to stern. I could see them examining the dead sailors, evidently for signs of life, and presently a party of them appeared from below dragging a little figure among them. The creature was considerably less than half as tall as the green Martian warriors, and from my balcony I could see that it walked erect upon two legs and surmised that it was some new and strange Martian monstrosity with which I had not as yet become acquainted.

As Sola and I entered the plaza a sight met my eyes which filled my whole being with a great surge of mingled hope, fear, exultation, and depression, and yet most dominant was a subtle sense of relief and happiness; for just as we neared the throng of Martians I caught a glimpse of the prisoner from the battle craft who was being roughly dragged into a near-by building by a couple of green Martian females.

And the sight which met my eyes was that of a slender, girlish figure, similar in every detail to the earthly women of my past life. She was as destitute of clothes as the green Martians who accompanied her; indeed, save for her highly wrought ornaments she was entirely naked, nor could any apparel have enhanced the beauty of her perfect and symmetrical figure.

As her gaze rested on me her eyes opened wide in astonishment, and she made a little sign with her free hand; a sign which I did not, of course, understand. Just a moment we gazed upon each other, and then the look of hope and renewed courage which had glorified her face as she discovered me, faded into one of utter dejection, mingled with loathing and contempt.

In the next chapters of this great serial, appearing in the May issue, John Carter plans his escape from the green men and learns of the lost races of Mars. May Modern Mechanics on sale at all newsstands April 1.

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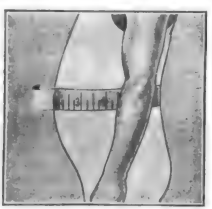
HOW TO BUILD the RUSSEL *Monoplane*

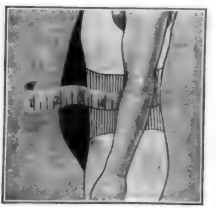
(Continued from Page 65)

Our next problem is to locate the center of gravity of the ship. We know that we must mount the wing on the fuselage in such a position that the center of pressure of the wing (approximately 32% from the leading edge), will be directly above the center of gravity.

How do we find the center of gravity? There are two methods used in doing this. If the motor is already mounted in the plane, we can simply place the whole assembly less wings, of course, on a knife edged support and move it about until it comes to a perfect balance on the support. Directly above the point of support (center of gravity), is the correct location of the center of pressure of the wing. This as mentioned before, will be found at approximately 32% of the wing chord using the leading edge as a datum line. This method is all right providing you make a good guess on the position of the motor.

Thanks to the science of mathematics, we can use another method of finding the center of gravity. This consists of assuming a position for the motor, propeller, gas tank, etc. We know the position of the other units such as fuselage, landing gear, pilot, instruments and tail assembly. Using the face of the front propeller flange as a





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datum line, we multiply the weights of the various units times their respective distances from this line and then divide the sum of all these by the total weight of the plane.

This will give us the exact location of the center of gravity. The center of gravity of the various individual units is usually located near their center, at least we can safely use this location in our calculations. With this method, we measure from the center of the propeller to the front flange and multiply this by the propeller weight. We then measure from the center of the motor to the front flange and multiply this distance by the motor's weight and so on down the line.

With the center of gravity found, it is a simple matter to mount the wing. The first thing to do is to place the fuselage assembly in a perfectly level position. This may be done by laying a level on the longerons between the first two vertical struts. This will give you the longitudinal position while laying a level on the first horizontal strut will give you the lateral position. We next hang a plumb bob from the ceiling to the center of gravity of the fuselage. Twelve inches above the first horizontal strut, is the location of the chord line of the wing. This gives us room for gas tank and cowling and also leaves ample space for vision straight ahead. The center of pressure of the wing (32%) of course, is placed at the position of the plumb line which is over the center of gravity.

With the wing in this position, we can now determine the dimensions of our wing struts. Our center or N struts, we find must be placed at an angle in order to run them from the spars to the fittings provided for them directly above the fuselage struts. This distributes the load equally on the longerons and also makes the bracing itself more rigid. The struts are made of ¾ in. 20 gauge steel tubing, flattened and drilled at one end and welded to the wing connection plate at the other as shown in the photo. The wing plates are made of ⅛-in. sheet steel. The flying struts or outer wing braces are also made of ¾-in. 20 gauge steel tubing fitting into sheet steel brackets on the spars and into the fuselage brackets at the lower ends.

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RUSSEL *Monoplane*

planes have their axle placed at approximately 15 degrees forward of the center of gravity. This is done in order to prevent the plane from nosing over in landing or taking off. We make our landing gear of the V strut type using the old reliable shock cord over a tubular axle—⅞-in. 18 gauge steel tubing is used for the struts and is fastened in the ear brackets provided for them on the fuselage. See photo and blueprint, which will give you more details of the landing gear construction. With 20 by 4 clincher wheels and 6 in. hubs we make our tread 60 inches which gives us a good solid footing. This width tread practically eliminates the possibility of wing damage when taxiing over rough ground. ⅛-in. cable is used for diagonal bracing in the landing gear and it is advisable to keep this taut by rigging it after each series of flights.

With the wings and landing gear mounted, and properly braced, we may now consider the motor mounting. To get the dimensions of this, we can use the figures we obtained in our center of gravity calculations or we can obtain them by again placing the ship on a pivot directly below the center of gravity. With the ship on the pivot block, the pilot in the cockpit, as in previous balancing, we place a board on top of the forward part of the fuselage, fastening it securely to same. We now take a bag of sand—equal to the weight of the motor and propeller—and shift it back and forth on the board until it brings the ship again into a state of balance. The bag of sand now represents our motor and by knowing the dimensions of the motor, it is easy to arrive at the dimensions of the motor mounting assembly. The mounting must provide for the motor at the exact position of the bag of sand. This is a positive method and if properly executed you will be assured the ship will balance at the proper point. This gives us the position of the motor in respect to the longitudinal center of gravity.

We must now fix the position of the motor in respect to its distance from the ground.

The motor must be placed in such a position that the tail units will get the full force of the propeller blast. This means that an ideal setting would place the crank-

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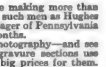

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STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912.

Of Modern Mechanics and Inventions, published monthly at Minneapolis, Minnesota, for Oct. 1, 1926.
State of Minnesota, County of Hennepin.

Before me, a Notary Public in and for the State and county aforesaid, personally appeared W. H. Taylor, who, having been duly sworn according to law, deposes and says that he is the Business Manager of the Modern Mechanics and Inventions and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers, are:

Publisher: W. H. Fawcett, Robbinsdale, Minnesota.
Editor: Reeve Fawcett, Robbinsdale, Minnesota.
Managing Editor
Business Managers: W. H. Taylor, Robbinsdale, Minnesota.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.)

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3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.)

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4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is.....(This information is required from daily publications only.)

W. H. Taylor, Business Manager

Sworn to and subscribed before me this 9th day of January, 1929.

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RUSSEL *Monoplane*

shaft of the engine in the same horizontal plane as the stabilizer.

We next install the tail skid. This is made of 1 in. x ¼ in. spring steel reinforced at the top and fastened by U bolts to the rear of the fuselage. The length of this is determined by the angle at which the ship rests on the ground. This we find is usually ten or fifteen degrees so that means that our tail skid must be 15 in. long.

Our next job is to get the ship "under control." We adopt the old reliable "joystick"—cable and pulley system—as we find this to be the most practical for our use. We make the control lever of ¾ in. 22 gauge steel tubing and place it approximately 6 inches in front of the pilot seat. This is welded to a U hinge which operates on the cross shaft, also made of steel tubing.

This shaft turns in sheet steel collars fastened to the plywood flooring.

We use 5/32, 7 x 19 aileron control cable which fastens directly to the control lever. It runs from this through 2 in. aluminum pulleys to the aileron hinges. A slight departure is made from the conventional method in constructing the elevator control. Instead of using cable for this, we use ½ in. 20 gauge steel tubing connected to an arm welded directly to the aileron front spar. Steel tubing is also used for the rudder bar.

Covering and Doping

With the control system installed we can now cover our ship. The forward part is covered with aluminum sheeting to reduce fire hazard. The remainder of the ship we cover with grade A cotton fabric. This is sewed as a bag, the shape of the unit to be covered and then stretched tightly over same.

After the covering is on we give it an initial coat of acetate dope. This thoroughly penetrates the fabric and causes the surface to become taut. After the first coat of dope is put on, we place scalloped tape (pinked) over the leading and trailing edges as well as over each seam. When the first coat is thoroughly dry, we apply a second coat of acetate dope. This is followed by three coats of nitrate dope and one coat of varnish. With this operation we finish the building of our ship.

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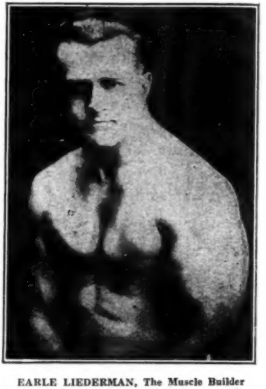

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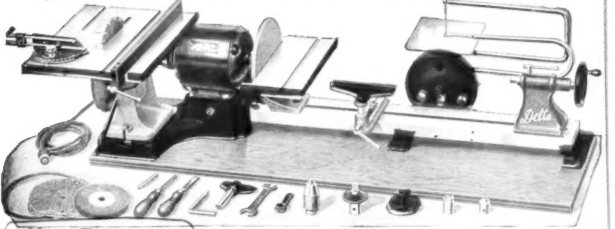

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Note the **two-shaft motor** that permits **two** or **three** operations **at one time**—the heavy Triple Foundation U-Shaped Lathe Bed (no rods)—the **practical** arrangement of the Circular Saw that permits the cutting of large lumber without interference—the Improved Tilting Tables on the Circular Saw, Sanding Disc, and Jig Saw. Has **automatically oiled** bronze bearings and is **completely assembled** on heavy veneered wood base.

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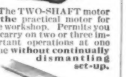

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